Quality Assurance Project Plan
Site Investigation

BP Products North America Incorporated
Site # 5482 – Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois

December 9, 2013

Prepared By:
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Prepared For:
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December 9, 2013

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Mr. Steve Faryan
On-Scene Coordinator
U.S. Environmental Protection Agency Region 5 (SC-5J)
77 W. Jackson Blvd.
Chicago, IL 60604

RE: Quality Assurance Project Plan – Site Investigation
Former Standard Oil Bulk Plant #5482
Wedron, LaSalle County, Illinois
EPA Docket No. RCRA 7003

Dear Mr. Faryan,

BP Products North America Inc. (BP) is submitting a Quality Assurance Project Plan to conduct site investigation activities in accordance with the Proposed Work Plan included in the Order on Consent dated September 30, 2013. Site investigation activities are being conducted on the property formerly leased by BP's corporate predecessor at the Wedron Ground Water Contamination Site located in Wedron, LaSalle County, Illinois.

Should you have any questions or require additional information regarding this document, please do not hesitate to contact me at (630) 420-5149.

Sincerely,

Mary Wojciechowski
Operations Project Manager

Attachment

Cc: Douglas Reinhart, BP Legal
Stantec
Project file

TITLE AND APPROVAL PAGE

Title of Plan: Quality Assurance Project Plan
Site Investigation
BP Products North America Incorporated
Site # 5482 – Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois

Prepared By: Stantec Consulting Services Inc.

Effective Date: December 9, 2013

_____

Ms. Mary Wojciechowski Atlantic Richfield Company Project Coordinator	Date
Ms. Luisa Price Stantec Project Manager	Date
Mr. James M. Kerr, Jr., L.P.G. IN469 Stantec Environment Practice QA/QC Manager	Date
Mr. Steve Faryan U.S. EPA Region 5 On-Scene Coordinator	Date
Ms. Lori Castille Pace Laboratories Project Manager	Date
Ms. Melanie Ollila Pace Laboratories Quality Assurance Manager	Date

By signing this page, the individual agrees to the conditions of this Quality Assurance Project Plan.

Stantec

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Acronyms and Abbreviations

°C	Degrees Celsius
%R	Percent Recovery
AOC	Administrative Order on Consent
bgs	Below Ground Surface
BN	Burlington Northern Railroad Company
BNSF	Burlington Northern Santa Fe Railroad Company
BP	BP Products North America Incorporated
BTEX	Benzene, Toluene, Ethylbenzene, Total xylenes
CBQ	Chicago, Burlington and Quincy Railroad Company
CFR	Code of Federal Regulations
CoC	Chain-of-Custody
DO	Dissolved Oxygen
DOP	Dilution of Precision
DQIs	Data Quality Indicators
DQO	Data Quality Objectives
DRO	Diesel Range Organics
EPA	U.S. Environmental Protection Agency
EM	Electromagnetic
FSP	Field Sampling Plan
GC/MS	Gas Chromatograph/Mass Spectrometer
GPR	Ground penetrating radar
GPS	Global Positioning System
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
LCS	Laboratory Control Sample
LMS	Learning Management System
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFG	National Functional Guidelines
NFR	No Further Remediation
ORP	Oxidation Reduction Potential
OSC	On-Scene Coordinator
OSFM	Office of the Illinois State Fire Marshall
OSHA	Occupational Safety and Health Administration
Pace	Pace Analytical Services, Inc.
PC	Project Coordinator

PID	Photoionization Detector
PM	Project Manager
ppm	Parts per million
QA	Quality Assurance
QAO	Quality Assurance Officer
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SDWA	Safe Drinking Water Act
SFDS	Sampling Field Data Sheets
SM	Site Manager
SOP	Standing Operating Procedure
Stantec	Stantec Consulting Services, Incorporated
SVOC	Semi-Volatile Organic Compounds
SW846	Solid Waste Method 846
TACO	Tiered Approach to Corrective Action Objectives
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
UTM	Universal Transverse Mercator
VOCs	Volatile Organic Compounds

1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, functional activities and specific quality assurance and quality control (QA/QC) activities associated with the BP Products North America Incorporated (BP) Former Standard Oil Bulk Plant #5482 Site Investigation project. This QAPP has been prepared as required by the Administrative Order on Consent (AOC) dated October 1, 2013. This QAPP also describes or includes by reference the specific protocols that will be followed for sampling, sample handling and storage, chain-of-custody (CoC) procedures, laboratory analysis, and field analysis.

QA/QC procedures will be in accordance with applicable professional technical standards, U.S. Environmental Protection Agency (EPA) and Illinois Environmental Protection Agency (IEPA) requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP was prepared by Stantec Consulting Services, Inc. (Stantec) in accordance with EPA QAPP guidance documents, in particular, EPA QA/G-5, Guidance for Quality Assurance Project Plans (2002); and QA/R-5, EPA Requirements for QA Project Plans (2001).

1.1 Distribution List

The following individuals will receive copies of the approved QAPP and any subsequent revisions:

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Minneapolis, MN 55414

2 PROJECT MANAGEMENT

2.1 Project/Task Organization

The project/task organization for this project will be structured as depicted on Figure 1. This organizational chart identifies the roles and responsibilities of those individuals involved with the project and their organization. It also provides a structure for lines of authority and reporting. The following subsections outline the general responsibilities for each member of the organizational structure. The BP Project Coordinator (PC) is responsible for implementing all aspects of the project under the AOC. The Stantec Project Manager (PM) takes direction from the BP PC and is responsible for communicating to the project team. The EPA Region 5 Quality Assurance Officer (QAO) will provide Quality Assurance as directed by the EPA On-Scene Coordinator (OSC).

2.1.1 EPA On-Scene Coordinator

The OSC has responsibility for overseeing implementation of the AOC. The OSC has the authority vested in OSCs by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) with respect to any response action undertaken by EPA or BP at the facility. The OSC has regulatory oversight responsibilities for the development and approval of the documents and reports for this project. The responsibilities of the OSC include, but are not limited to, the following:

- Schedule meetings, if necessary, between the OSC, agencies and representatives of BP;
- Review and approve means and methods of operations;
- Review and approve proposed schedules;
- Review and approve resource allocations;
- Review and approve documents and reports; and
- Provide data quality assurance decisions, as necessary.

2.1.2 BP Project Coordinator

The BP PC is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The PC will communicate directly to the OSC. All communication and reporting will be approved by the PC. The PC's primary function is to ensure that technical, financial and scheduling objectives are achieved successfully. The responsibilities of the PC include, but are not limited to, the following:

- Oversee project objectives and develop a detailed work schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;

- Acquire and apply technical and corporate resources as needed and appropriate to ensure performance within budget and schedule constraints;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure its quality, responsiveness and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all reports (deliverables) before their submission to the EPA;
- Ultimately be responsible for the preparation and quality of interim and final reports;
- Represent the project team at meetings and public hearings; and
- Submit progress reports to the EPA as required.

2.1.3 Stantec Project Manager

The PM is responsible for establishing project scope and objectives and communicating to the project team. The PM is also responsible for identifying internal, regulatory, and procedural requirements pertinent to the work that may differ from accepted industry standards of work. The PM may talk with regulatory agencies regarding methodologies and requirements. The responsibilities of the PM include, but are not limited to, the following:

- Monitor staff performance and project progress;
- Establish budgets and schedules;
- Assure the provision of necessary resources including personnel, facilities and equipment;
- Review and approve standard operating procedures (SOPs), training records and purchasing actions and other project documents with the input of the Stantec QAO and the Site Manager;
- Monitor laboratories for proper turnaround times;
- Support the efforts of the Site Manager and Stantec QAO in all matters concerning the quality of work products;
- Assure effective response to corrective action requirements identified by any member of the project team or staff;
- Ensure proper equipment, personnel and subcontractor resources are allocated and that respective activities are planned;
- Provide a liaison between the client, field staff, laboratory staff and any other subcontractors;
- Effectively carry out the Quality Assurance (QA) Program and the Field Sampling Plan (FSP); and
- Assure completion of corrective actions as needed.

2.1.4 Stantec Quality Assurance Officer

The Stantec QAO is independent from the collection of samples. The QAO reports to the Project Manager who has the authority to take any actions necessary to ensure the reliability and validity of work and deliverables according to the QAPP. The QAO is responsible for developing and implementing procedures to appropriately document all project activities, to provide specific means of measuring conformance to specifications, to manage the corrective actions program and to provide periodic reports to Management. The responsibilities of the QAO include, but are not limited to, the following:

- Maintain and implement QAPP procedures;
- Develop, document and implement QA activities to ensure that appropriate Quality Control (QC) measures are being executed and documented;
- Ensure all records related to QA/QC are documented, maintained securely and retrievable;
- Conduct periodic performance audits and/or surveillances to measure conformance to specifications;
- Prepare periodic quality reports and QA sections of final reports;
- Ensure corrective actions are carried out and documented in a way that precludes future occurrences; and
- Acquire and maintain required certifications and manage performance evaluation tests.

2.1.5 Stantec Site Manager

The Stantec Site Manager (SM) is responsible for implementing the FSP to accomplish the project objectives. The SM reports directly to the Project Manager. The SM is responsible for all sample collection, processing and reporting in accordance with the QAPP. The responsibilities of the SM include, but are not limited to, the following:

- Compliance to the project schedule and objectives;
- Oversight of field equipment calibration, sample collection teams, field documentation, submission of samples to laboratories, and preparation of a summary report;
- Coordination of the day-to-day activities of the various sample teams under his or her supervision to support collection of samples;
- Implementation of QC for technical data provided by the field staff including field measurement data;
- Identifying problems at the field team level and documenting corrective action procedures;
- Address any CoC discrepancies or laboratory QA/QC anomalies;
- Monitor laboratory for proper turnaround times;
- Receipt of analytical data, checking for completeness and making sure that appropriate QA checks have been performed;
- Management of sample location data, field measurements and analytical results; and

- Maintenance of appropriate security measures to ensure data integrity.

2.1.6 Laboratory

Samples for laboratory analysis will be shipped via overnight courier to an off-site laboratory. The laboratory for this project will be Pace Analytical Services, Inc. (Pace), located in Minneapolis, Minnesota. The laboratory organizational structure is outlined in the laboratory Quality Assurance Manual (QAM), provided as Appendix A.

2.1.7 Laboratory Quality Assurance Officer

The responsibilities of the laboratory QAM include, but are not limited to, the following:

- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality. They may also report to a Senior Quality Manager within the same facility;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The QAO is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions; and
- Maintains the currency of the Quality Manual.

2.1.8 Laboratory Project Manager

The responsibilities of the laboratory PM include, but are not limited to, the following:

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate staff to develop project statements of work or resolve problems of data quality;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Arranges bottle orders and shipment of sample kits to customers; and
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

2.1.9 Laboratory Manager

The responsibilities of the laboratory manager include, but are not limited to, the following:

- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately
- understood and met;
- Works with SGM/GM to prepare appropriate budget and staffing plans for all departments;
- Responsible for prioritizing personnel and production activities within all departments; and
- Performs formal and informal performance reviews of departmental staff.

2.1.10 Stantec Data Validator

The Stantec Data Validator is a Stantec employee who is independent from the collection of samples and will be otherwise uninvolved with the project. The Data Validator for this project is Ms. Beth Crowley (see Figure 1). Ms. Crowley has a BS in Chemistry, has worked in analytical laboratories for 10 years, and has been validating data according to EPA standards for over 15 years. All laboratory data will be furnished with a Level II data package; 100% of this data will receive data verification by the data validator. The laboratory will be instructed to have available, upon request, all of the data required to furnish Level IV data packages. The Data Validator will select 10% of the data from each matrix and request Level IV data packages from the laboratory. Full data validation of these Level IV data packages will be conducted following the EPA National Functional Guidelines (NFG) for Inorganic and Organic Data Review

(2008/2010). If systematic issues or problems are identified during the data validation process, additional Level IV data packages may be requested for review and validation. The Data Validator will communicate data issues and final validation reports to the QAO for evaluation of any potential corrective actions and for final reporting.

2.2 Problem Definition/Background

2.2.1 Project Objective

The objective of the project is to characterize the fill and subsurface materials to help delineate the presence or absence of gasoline-related constituents on the property. The objective will be measured in terms of detected subsurface structures potentially used during historical bulk oil operations and detected soil and/or groundwater concentrations of volatile organic compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), total lead, and total petroleum hydrocarbons (TPH) as gasoline- and diesel-range organics (GRO/DRO) as detailed in the approved Workplan (BP, September 19, 2013; Exhibit A to Administrative Order on Consent). Site activities supported by this QAPP include:

- Geophysical and property boundary survey;
- Subsurface soil sampling;
- Groundwater monitoring well installation; and
- Groundwater sampling.

2.2.2 Site Description

BP Site # 5482 – Former Standard Oil Bulk Plant is a former bulk petroleum storage and distribution facility located on a railroad right-of-way on the east side of Wedron, LaSalle County, Illinois, adjacent to County Highway 11 (depicted on Figure 2).

2.2.3 Background

The property is located on railroad right-of-way currently owned and operated by Illinois Railway, LLC on the east side of Wedron, Illinois along County Highway 11. BP's corporate predecessor, Standard Oil Company (Indiana) leased the property from the Burlington Northern Santa Fe Railroad Company (BNSF) (former Burlington Northern Railroad Company (BN) and Chicago, Burlington & Quincy Railroad Company (CBQ)) from approximately 1921 to December 1971. The property was used for petroleum bulk plant operations as part of a fuel sales route in Wedron, Illinois. Site plans attached to leases dating from 1926 to 1942 indicate the presence of a warehouse and two storage tanks. Additionally, Standard Oil leased a limited area between the property and railroad to accommodate above ground, two-inch diameter unloading pipes and a tank car unloading rig. Historical correspondence indicates that by December 1971, the warehouse (garage), oil storage tanks, unloading pipes and storage barrels were removed from the property.

Previous investigations adjacent or near the property include the July 2012 removal of a 560-gallon, gasoline underground storage tank (UST). UST removal was completed by Underground Storage Tank Specialists, Inc. on behalf of Illinois Railway, LLC. As part of the removal, approximately 200 gallons of residual fuel and water was pumped from the UST and approximately 80 tons of impacted soil surrounding the former UST was removed and disposed of at the Laraway Landfill facility in Joliet, Illinois. A total of twelve (12) confirmation soil samples were collected from the floor and sidewalls of the former UST system and the excavated areas; soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and total xylenes (BTEX), and total lead. During the UST removal, a representative of Illinois Railway, LLC contacted the Illinois Emergency Management Agency (IEMA) and Incident # 20120767 was assigned to the release. A 45-Day Report/Corrective Action Completion Report which provided a summary of the removal activities and data collection was submitted to the IEPA on August 7, 2012. The report requested a No Further Remediation (NFR) letter for the incident and the IEPA approved the request and granted a NFR for the release on August 20, 2012.

On August 23, 2012, a Site investigation was completed by CDM Smith at the property. As part of the assessment, six (6) soil borings were advanced in the area of the former UST at depths ranging from 16 to 24 feet below ground surface (bgs). Two soil samples were collected from each soil boring location and were submitted for laboratory analysis of BTEX and total lead. No analyzed parameters were identified in exceedance of the Illinois Tiered Approach to Corrective Action Objectives (TACO) – Tier 1 industrial/commercial soil remediation objectives. Lead was detected in the samples ranging from 2.3 to 30 parts per million (ppm). Groundwater was not encountered during the investigation. The data was summarized in a report prepared on behalf of Illinois Railway, LLC, titled *Voluntary Environmental Site Assessment, Illinois Railway Easements* (October 2012).

On May 16, 2013, one soil sample was collected by the EPA near the former bulk plant and analyzed for VOCs as part of a larger investigation completed in association with the EPA – Wedron Groundwater Contamination Site. Benzene was detected at concentrations greater than TACO standards for the soil component of the groundwater ingestion exposure route for Class I groundwater.

2.3 Project/Task Description

The implementation of the project may include the following tasks:

- Geophysical survey;
- Property boundary survey;
- Subsurface soil boring installation and soil sampling;
- Groundwater monitoring well installation and groundwater sampling; and
- Reporting.

Sampling and analysis of all media will be conducted in accordance with the FSP. As stated in the approved Work Plan, a FSP will be submitted to EPA within 30 days after receipt of the results of the geophysical survey.

All sampling locations will be identified using global positioning system (GPS) instruments. Equipment must be capable of readings that are accurate to 3 meters or less. Dilution of precision (DOP) values will be recorded for each reading. DOP values of less than 6 will be considered acceptable for location. A minimum of 4 satellites will be acquired by the instrument prior to recording of the location.

All sampling locations will be recorded in Universal Transverse Mercator (UTM) coordinates in feet using the NAD83 datum. Northing and Easting values will be recorded in the field logbook.

2.3.1 Geophysical Survey

A geophysical survey will be completed for the property and a portion of the adjacent right-of-way associated with the location of former piping (Figure 3) using a Ground Penetrating Radar (GPR) and electromagnetic (EM) survey to identify the potential presence of metallic objects. If the results of the survey indicate the potential presence of a metallic object, the area will be marked for further investigation. The investigation will include carefully excavated test pit(s) to identify the source of the survey readings. If an object is identified as an UST or associated piping, it will be removed under the supervision of the Office of the Illinois State Fire Marshal (OSFM). Additionally, sampling and reporting in accordance with Illinois regulations will be completed to obtain regulatory closure of the UST removal. The survey will also be used to identify potential unknown or abandoned buried utilities prior to conducting drilling activities. If identified, these utilities will be clearly marked and avoided during any subsurface activities. QA/QC measures for geophysical survey activities are included as Appendix B.

2.3.2 Property Boundary Survey

The boundaries of the property will be confirmed using a professional land surveying company. In addition, GPS technology will be utilized to confirm the locations of the previous investigations as compared to the property. The survey data and GPS data will be used to accurately display the spatial location of the property and previous investigations.

2.3.3 Subsurface Soil Boring Installation and Soil Sampling

A minimum of nine (9) soil borings will be advanced on the property utilizing direct push technology and following the procedures detailed in SOP-001 (Appendix C). The proposed boring locations will be dependent on site conditions, accessibility, and the results of the geophysical survey and utility locate effort; however, a conceptual layout of proposed soil borings is presented on Figure 3. A minimum of two (2) subsurface soil samples will be collected from each boring location and analyzed for VOCs, SVOCs, total lead, and TPH as

GRO/DRO. Quality control samples will be collected in the field, including field duplicates, trip blanks, and matrix spike/matrix spike duplicates (MS/MSD). Proposed locations will be included in the Field Sampling Plan (FSP) and will be provided to the EPA for review and approval following completion of the geophysical survey.

2.3.4 Groundwater Monitoring Well Installation and Groundwater Sampling

If any soil results indicate the presence of impacted soils above TACO Tier 1, Class I soil component of groundwater ingestion remediation objectives, a minimum of three (3) monitoring wells will be installed. If several boring locations indicate soil concentrations above TACO Tier 1, Class I soil component of groundwater ingestion remediation objectives, the areas with more elevated concentrations will be targeted for monitoring well installation. Groundwater monitoring wells will be installed using a truck-mounted drill rig and will be constructed of 2-inch, inside diameter polyvinyl chloride (PVC) casing and factory slotted screen. Upon installation, groundwater samples will be collected from each monitoring well location and analyzed for VOCs, SVOCs, and TPH as GRO/DRO. Groundwater concentrations will be compared to TACO Tier 1 groundwater remediation objective. TACO reference tables are attached as Appendix D. Monitoring well locations will be presented in an updated FSP and will be provided to the EPA for review and approval.

2.3.5 Reporting

A Technical Memorandum will be provided to the EPA within 45 days following completion of field activities and receipt of analytical results.

2.3.6 Work Schedule

The approved Work Plan (BP, September 19, 2013; Exhibit A to AOC) contains the schedule of field and reporting activities.

2.4 Quality Objectives and Criteria

The overall QA objectives are to develop and implement procedures for field sampling, CoCs, laboratory analysis, and reporting that will provide the level of data required to determine the characteristics of the various environmental media. Specific procedures for sampling, CoCs, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives requested by EPA for Data Quality Objectives (DQO), ensuring that data of known and appropriate quality are obtained and that data are sufficient to support the intended use as specified in the AOC. Data collected will be validated in terms of Data Quality Indicators (DQIs): precision, accuracy, completeness, representativeness, comparability and sensitivity. The fundamental QA objective with respect to precision, accuracy, and sensitivity of laboratory analytical data is to achieve the

QC acceptance of the analytical protocols and thereby meet the project objectives. Table 1 presents a comprehensive overview of the data validation and acceptance criteria. DQIs for field measurements (such as GPS, pH, temperature, specific conductance, and oxidation/reduction potential (ORP)) will be based on the appropriate SOP and the manufacturer's requirements for the instrument.

2.4.1 Project Quality Objectives

The project quality objectives process is a series of planning steps designed so that the type, quantity and quality of data used in decision making are appropriate for the intended application. Five steps can be considered in the project quality objectives process and include problem statement, decision identification, decision inputs, assessment boundary and the decision process. The details of these steps are provided in the following sections.

2.4.1.1 Problem Statement

Petroleum constituents were reported in several drinking water wells in the southeastern portion of the Wedron community in 1982, and more recently in 2011, and have been reported in drinking water wells at concentrations that exceeded TACO Class I Tier I residential groundwater levels.

2.4.1.2 Decision Identification

Evaluation of the nature and extent of the presence and/or release of hazardous wastes and/or hazardous constituents at certain locations on the former Standard Oil Bulk Plant property using a phased approach, comparing soil analytical results to Illinois TACO Tier 1 Class I soil component of groundwater ingestion remediation objective will permit evaluation of whether potential source areas exist that require additional characterization and/or investigation.

2.4.1.3 Decision Inputs

Data obtained through the collection and analysis of soil and possibly groundwater samples, as described in the Workplan, from the various locations on the former Standard Oil Bulk Plant property will be used to evaluate whether potential source areas exist that require additional characterization and/or investigation. The soil analytical data will be compared to TACO Tier 1 Class I soil component of groundwater ingestion remediation objective. Data obtained through the measurement of groundwater levels within the installed monitoring well network will be used to assess the groundwater-flow configuration across the Wedron community.

2.4.1.4 Assessment Boundary

For the portions of the Workplan with objectives of evaluating the presence of petroleum constituents in soil, the horizontal assessment boundary is identified by the area covered by the proposed borings identified on Figure 3. If TACO Tier 1 Class I soil component of groundwater

ingestion remediation objective are exceeded in soil samples submitted for laboratory analyses, the horizontal boundary may expand in a follow-up evaluation to cover the area of TACO Tier 1 Class I soil component of groundwater ingestion remediation objective exceedances, assuming that the area does not extend beyond the boundaries of the former Standard Oil Bulk Plant Site. The assessment boundary for evaluating groundwater-flow configuration is bounded by the area of groundwater measurements and covers nearly the entire Wedron community.

The vertical assessment boundary for soil is soil boring depth of refusal or the top of bedrock. The vertical assessment for evaluating groundwater-flow configuration is the water table.

2.4.1.5 Decision Process

A decision for follow-up investigation activities will be based on a comparison of detected VOC constituents to Illinois TACO Tier 1 Class I soil component of groundwater ingestion remediation objective. If soil VOC concentrations for samples collected are less than TACO Tier 1 Class I soil component of groundwater ingestion remediation objective, additional investigation will be unnecessary. If TACO Tier 1 Class I soil component of groundwater ingestion remediation objective are exceeded, groundwater monitoring wells will be installed. If additional investigation of soil and/or groundwater is warranted, a separate work plan will be prepared and submitted to the USEPA.

The applicable soil and groundwater levels for VOCs, which will be used to evaluate the need for follow-up investigation activities, are presented in applicable subsections of IEPA Title 35: Environmental Protection; Subtitle G; Chapter I; Subchapter D.

2.4.2 Precision

2.4.2.1 Definition

Precision is a measure of the agreement of repeated measurements taken from the same sampling location.

2.4.2.2 Field Precision Objectives

Precision of field measurements (such as GPS, pH, temperature, specific conductance, and ORP) will be based on the appropriate SOP and the manufacturer requirements for the instrument. Precision of field sample collection will be assessed through the collection and measurement of field duplicates and MS/MSD and the evaluation of the relative percent differences (RPD) between duplicate pairs. Field duplicates and MS/MSD samples will be collected at rate of approximately one for every 20 analytical samples collected. Field duplicates for soil will be collected from the same sample interval as the original sample. For groundwater samples, samples will be collected from the same depth and time as the original sample. The precision objective for this project will be a field duplicate RPD of 25% for water

and 50% for solids and an MS/MSD RPD of 30% for water and solids, with the exception of GRO (water and solids) and lead (water) that have a MS/MSD RPD of 20%. The equation for RPD can be found in Section 5.1.8. Field duplicate and MS/MSD frequency for soil and groundwater are presented in Table 2 and Table 3 respectively.

2.4.2.3 Laboratory Precision Objectives

Precision in the laboratory is assessed through analysis of a laboratory control sample (LCS), MS/MSD or MS and Laboratory duplicates, and field duplicate pairs and the evaluation of the RPD between duplicate pairs. Laboratory accuracy and precision limits are presented in Table 4 and Table 5.

2.4.3 Accuracy

2.4.3.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

2.4.3.2 Field Accuracy Objectives

Accuracy of field measurements (such as GPS, pH, temperature, specific conductance, and ORP) will be based on the appropriate SOP and the manufacturer requirements for the instrument. Accuracy of field sample collection will be assessed through the use of trip and equipment blanks to assess the potential for cross-contamination. All coolers containing samples selected for volatiles analysis will also contain a trip blank sample. Field trip and equipment blank frequency and sample handling preservation and holding time criteria are presented in Table 2 and Table 3.

2.4.3.3 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through the analysis of MS/MSD, laboratory duplicates, Laboratory Control Sample (LCS), surrogate compounds or equivalent and the determination of percent recoveries (%R). The equation for accuracy can be found in Section 5.1.9. Laboratory accuracy and precision limits are presented in Table 4 and Table 5.

2.4.4 Completeness

2.4.4.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system.

2.4.4.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from the field measurements taken during the project. The equation for completeness is presented in Section 5.1.10 of this QAPP. The field completeness objective for this project is greater than 95%.

2.4.4.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 5.1.10 of this QAPP. The laboratory completeness objective for this project is greater than 95%.

2.4.5 Representativeness

2.4.5.1 Definition

Representativeness expresses the degree to which collected data are characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition within a defined spatial and/or temporal boundary.

2.4.5.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the protocols within the FSP and this QAPP are followed. These protocols will include the analysis of trip blank and equipment blank data as well as calibration and documentation review of field instruments. Review of sampling and analysis methods are discussed in Section 5.1.

2.4.5.3 Measures to Ensure Representativeness of Laboratory Data

Laboratory representativeness is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing and assessing field duplicate samples. The sampling network was designed to provide data representative of the facility conditions. Review of laboratory sampling and analysis methods are discussed in Section 5.1.

2.4.6 Comparability

2.4.6.1 Definition

Comparability is an expression of the confidence that one data set can be compared to another.

2.4.6.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that proper sampling techniques are used. Review of sampling and analysis methods are discussed in Section 5.1.

2.4.6.3 Measures to Ensure Comparability of Laboratory Data

Analytical data will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability is also dependent on similar QA objectives and will be measured through QA split samples. Review of laboratory data is discussed in Section 5.1.

2.4.7 Sensitivity

2.4.7.1 Definition

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

2.4.7.2 Measures to Ensure Sensitivity of Laboratory Data

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be identified, measured and reported with a 99% confidence, given that the analyte concentration is greater than zero and is determined from repeated analysis of a sample in a given matrix containing the analyte. Laboratory MDLs have been determined as required in Title 40 of the Code of Federal Regulation (CFR) Part 136B. The reporting limit (RL) is greater than or equal to the lowest standard used to establish the calibration curve. Results greater than the MDL and less than the RL will be qualified as "estimated" by the laboratory. Laboratory MDLs and RLs are summarized in Table 4 and Table 5.

Sample results resulting from dilutions, which have non-detect results and reporting limits above regulatory/screening criteria will be flagged "UJ" indicating that the non-detect result is not sensitive enough to meet the criteria.

2.4.7.3 Field Equipment Sensitivity

During soil sampling activities, an UltraRAE 3000 (or equivalent) photoionization detector (PID) will be used to screen soil vapors for the presence of total VOCs and/or benzene. When used in the total VOC mode the PID will have a detection range of 0.05 to 9999 ppm with a sensitivity of less than or equal to 1 ppm. When used in the compound-specific benzene mode the PID will have a detection range of 0.05 to 200 ppm with a minimum sensitivity of 0.05 ppm.

2.5 Special Training Requirements and Certification

2.5.1 Special Training

Field tasks will potentially consist of sampling soil and groundwater. The Site Manager will ensure that personnel completing these activities have sufficient knowledge and on-the-job training to follow the procedures required for the activities discussed in this QAPP and that field personnel have completed the Occupational Safety and Health Administration (OSHA)-approved basic 40-hour health and safety training, Hazardous Waste Operations and Emergency Response (HAZWOPER) course, and the respective annual refresher courses. Stantec's BP Control of Work procedures must be followed. All Stantec employees and subcontractors working on site must complete BP's Site Orientation annually and have BP US Pipeline Harmonized Training. Personnel training requirements and record retention requirements are included in the site Health and Safety Plan (HASP), and sample collection procedures are included in the SOPs (Appendix C).

The Data Validator will meet the following training requirements:

- Degree in Chemistry;
- Worked in an analytical laboratory for 3 years as a chemist; and
- An understanding of EPA methods and guidelines.

Laboratory requirements for laboratory analysts are listed in the laboratory QAM (Appendix A).

2.5.2 Laboratory Certification

Laboratory certifications are listed in Attachment VI of the QAM (Appendix A).

2.6 Document Dissemination

Dissemination of the QAPP and any EPA approved revisions to the QAPP will be the responsibility of the QAO or QAO assigned designee.

2.6.1 Data Reporting

2.6.1.1 Field Data

Field measurements and observations will be recorded in accordance with the SOPs provided in Appendix C.

2.6.1.2 Laboratory Data

The hard copy and the electronic copy of the laboratory data will be reported following the format identified below. For this project, a QC summary package will be required for Level II data analysis. The contents of the QC summary package will include:

- Cover sheet;
- Laboratory narrative;
- Laboratory blanks;
- Cooler receipt forms;
- CoC copies;
- Analytical results;
- Surrogate summary results;
- LCS summary results; and
- Spike and laboratory duplicate summary results.

Level IV data analysis will include the raw data package which consists of elements presented in the QC summary as well as the raw data. Raw data will include chromatograms, mass spectra, manual integration correction data, quantitation reports, calibration data, preparation logs and analytical logs.

Data verification will be completed on 100% of laboratory samples; data validation will be completed on 10% of laboratory samples. All data will be verified/validated manually and qualifiers (flags and changes) are added to the database by the validator or database person. The data changes and flags are then reviewed against the hardcopy by the validator for accuracy.

Both laboratory and field data will be combined and summarized in final tables and graphs that are appropriate to the type of data and convey information to support the findings of the data collection program. In all cases, data will be clearly tabulated and presented in a consistent manner for comparison of common data sets.

All soil and groundwater laboratory analytical data generated during the implementation of the AOC will be validated and submitted in tabulated form to EPA within 30 days of receipt of data.

2.6.2 Records Disposition and Retention Schedule

BP shall retain all documents relating to the project for ten (10) years following completion of the Work required by the AOC. Before destroying any documents, BP shall notify EPA that the documents are available to the EPA for inspection and, upon request, must provide the originals or copies of the documents to the EPA. In addition, BP shall provide these documents at any time before the ten (10) year period expires at the written request of the EPA.

All project files and records will be stored at the Stantec – Lombard, Illinois office in a dedicated filing cabinet and retained as required by applicable record retention requirements. Project information can be attained through a written request to the PC.

3 DATA GENERATION AND ACQUISITION

3.1 Sampling Process Design

3.1.1 Sampling Procedures and Methods

Sampling procedures and methods are detailed in Stantec's SOPs, which are included as Appendix C to the QAPP and listed below:

- ERPA-001 – Soil Sampling, November 2011;
- ERPA-002 – Decontamination Procedures, April 2011;
- ERPA-003 – Monitoring Well Installation, April 2011;
- ERPA-005 – Low Flow Groundwater Sampling, November 2011;
- ERPA-006 – Groundwater Sampling, April 2011;
- ERPA-011 – Field Notebook, November 2011;
- ERPA-301 – Field Report Form, April 2011;
- ERPA-302 – Variance/Time Delay (form), April 2011;
- ERPA-303 – Waste Management (form), April 2011; and
- ERPA-306A – Groundwater Sampling Field Data Sheet (form), April 2011.

3.1.2 Locations

Final soil sample and, if necessary, groundwater sample locations will be updated following the completion of the geophysical survey and provided to EPA in the FSP. The location of sampling points will be surveyed and recorded using GPS coordinates.

3.1.3 Custody Procedures

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility, relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final project files. Final project files, including originals of all laboratory reports, are maintained under document control in a secure area.

A sample or project file is under your custody if:

- The item is in actual possession of a person;
- The item is in the view of the person after being in actual possession of the person;
- The item was in actual physical possession but is locked up to prevent tampering; or
- The item is in a designated and identified secure area.

3.1.4 Field Custody and Documentation Procedures

3.1.4.1 Field Logbook

Field logbooks will provide the means of recording data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that a particular situation can be described without reliance on memory.

Field logbooks will be bound field survey books or notebooks. A project-specific document number will identify each logbook. The Site Manager will be responsible for assigning and tracking the numbers, as well as collecting and filing the completed books.

The title page of each logbook will contain the following:

- Log book number;
- Project name; and
- Project start date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather and names of all sampling team members present will be recorded. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed and dated. If an incorrect entry is made, the information will be crossed out with a single strike mark that is signed and dated by the person making the change. Whenever a sample is collected or a measurement is made, a detailed description of the location, which may include compass and distance measurements or GPS coordinates, will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

At the end of the day, the person making the entries will sign and date the log book at the bottom of the last page for that day on a line put across any unused page space.

Additional detail on field logbooks is provided in the SOPs (Appendix C).

3.1.4.2 Chain-of-Custody

The purpose of the CoC procedure is to prevent misidentification of samples, prevent tampering of the samples during shipment and storage, allow easy identification of tampering and allow for easy tracking of possession. If the CoC is broken at any time from sample collection through sample analysis, the QAO will be notified. The QAO is responsible for implementing corrective action and responsible for ensuring that all necessary documentation is completed.

If an incorrect entry is made on the CoC, the incorrect information will be crossed out with a single strike mark and the change initialed and dated by the person making the CoC change. A copy will be kept by the sampling team and will be included in the field activity documentation file.

The laboratory will compare the samples entered on the CoC forms with the sample containers received by the laboratory. If the laboratory finds any discrepancies, the laboratory will contact the Site Manager for resolution. The CoC forms will be the primary source of information for the laboratory to enter data into the laboratory's sample tracking system. Sample cooler packaging is an integral part of field activities. Procedures for proper sample packaging will be followed as directed in the SOPs (Appendix C).

A copy of the laboratory's CoC is provided as Appendix E.

3.1.4.3 Groundwater Sampling Field Data Sheet

To supplement the information recorded in the field logbook, groundwater sampling field data sheets (SFDS) may also be completed for each sampling location. The SFDS will include the sample data as well as coordinates of the sampling location. The SFDS will be cross-checked for completeness and accuracy by the Site Manager or Site Manager's assigned designee. The SFDS will be signed and dated by the sampler making entries on the SFDS. A copy of the SFDS is included in the SOPs (Appendix C).

3.1.4.4 Field Custody Procedures

Samples will be collected following the procedures directed in the SOPs (Appendix C). The equipment used to collect samples will be noted in the field logbook, along with the time the sample was collected, a description of the sample, the depth at which the sample was collected, the volume of sample collected and the number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive a unique sample identification number, will be noted in the field logbook and on the SFDS, if applicable.

The sample packaging and shipment procedures summarized below will be followed to ensure that the samples will arrive at the laboratory with the CoC intact. The protocol for specific soil and groundwater sample numbering is detailed in Section 3.1.4.6 and Section 3.1.4.7 respectively.

- The sample collector is personally responsible for the care and custody of the samples until they are relinquished or properly dispatched. Field procedures have been designed such that as few individuals as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis.

- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather. Sample labels will be affixed to the sample containers using clear tape.
- A properly completed CoC form will accompany all samples. The sample numbers and locations will be listed on the CoC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.
- Samples will be properly packaged on ice at a temperature less than or equal to 6 degree Celsius (°C) for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler.

3.1.4.5 Sample Labeling

Sample jars and vials will be clearly labeled with, at a minimum, the following information:

- Unique sample designation;
- Sample Type (discrete or composite area);
- Sampler name or initials;
- Date sample collected;
- Time sample collected; and
- Analysis to be performed.

3.1.4.6 Soil Sample Identification

Soil samples will be designated as follows:

Site – Sample Location #/ Sample Type– Depth Interval (in feet)

Examples:

- BPWI-SB01-6/8
- BPWI-TP04-0/2
- BPWI-TP03MSMSD-4/6

Site List:

- BPWI – British Petroleum Wedron Illinois

Sample Type List:

- DUP – Duplicate (samples will be submitted blind)

- EX – Excavation Sample
- HA – Hand Auger
- MS – Matrix Spike
- MSD – Matrix Spike Duplicate
- SB – Soil Boring
- TP – Test Pit

3.1.4.7 Water Sample Identification

Water samples collected from the groundwater monitor well network will be designated as follows:

Site – Sample Location or Type – Sample Date (mmddyy)

Examples:

BPWI – MW03 – 040713

- BPWI – TRIP BLANK – 012513

Site List:

- BPWI – British Petroleum Wedron Illinois

Sample Location or Type List:

- DUP – Duplicate (samples will be submitted blind)
- MS – Matrix Spike
- MSD – Matrix Spike Duplicate
- MW – Monitor Well
- PZ – Piezometer
- TRIP BLANK – Trip Blank

3.1.5 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and login, sample storage and numbering; tracking during sample preparation, and analysis and storage of data are described in the laboratory QAM (Appendix A).

3.1.6 Project File

The final project file will be the central repository for all documents, which constitute data relevant to sampling and analysis activities as described in this QAPP. The Stantec – Lombard, Illinois office is the custodian of the project file and maintains the contents of the file for the site activities, including all relevant records, reports, logs, field logbooks, pictures, subcontractor

reports and data reviews in a secured area. Removal of the project file and any material within will be approved by the Project Manager or Site Manager and will be documented with a "check-out" system that will identify the name of the document user, the date of document removal and the date of document return to the project file.

The final project file will include at a minimum:

- Field logbooks;
- Field data and data deliverables;
- Photographs;
- Drawings;
- Soil boring logs;
- Laboratory data deliverables;
- Data review/validation reports;
- Data assessment reports;
- Progress reports, QA reports, interim project reports, etc.; and
- All custody documentation (tags, forms, air bills, etc.).

3.2 Analytical Methods

Analytical methods have been selected to provide adequate detection limits for compounds of interest, and for the final intended data usage. All solid sample results will be provided on a dry weight basis as the methodology specifies. Laboratory SOPs are based on an analytical method published by the EPA, Standard Methods or other recognized sources as available.

3.2.1 Field Analytical Procedures

Field analytical measurements for aqueous and soil samples and their respective field instrument are listed in the following table:

Field Measurement	Field Instrument
DO, ORP, specific conductivity, pH and temperature.	YSI ProPlus or 556 Plus or equivalent
Head space soil vapors (Total VOCs and/or benzene)	UltraRae 3000 Photoionization detector or equivalent

3.2.1.1 Field Screening Procedures

During the collection of subsurface soil samples, headspace soil vapors will be screened for total VOCs and/or for benzene using a PID . Upon retrieval of the sample, the sample will placed on a clean surface (or lined with disposable aluminum foil or plastic sheeting) and will be

screened with a PID for detection of potential elevated PID readings. If applicable, a representative grab sample will be collected along with a headspace sample and placed into the appropriately labeled sample container. The sample containers will be placed in self-sealing plastic or bubble bags in a cooler with ice or frozen ice packs for storage until they are delivered to the analytical laboratory.

The following method is to be used for headspace screening:

- The portion (for headspace screening) will be placed into an appropriately sized re-sealable polyethylene bag (Ziploc® or equivalent);
- The bag will be sealed and labeled with the borehole identification and the depth of the sample;
- The sample will be allowed to equilibrate for approximately 10 minutes; and
- The probe tip of the PID will be inserted into the bag, and a measurement obtained using the PID.

The remainder of the sample shall be logged in accordance with ERPA-001

3.2.2 Laboratory Analytical Procedures

The contract laboratory will implement the project-required SOPs. These laboratory SOPs for sample preparation, cleanup, and analysis are based on the latest EPA-approved addition of "Test Method for Evaluating Solid Waste (SW-846), or consistent with all method requirements under the Safe Drinking Water Act (SDWA) and other applicable methods. The analytical procedures will follow laboratory in-house limits as appropriate. The laboratory will report all detections above the MDL. Values above the MDL and below the RL will be qualified as estimated. MDLs were determined as outlined in 40 CFR, Part 136B. The RLs are typically three to five times the MDL (the MDL should be below half any applicable action level where achievable). Laboratory MDLs and RLs are summarized in Table 4 and Table 5. Laboratory retention and disposal policies are detailed in Section 2.10 of the laboratory QAM (Appendix A).

3.2.2.1 VOCs

Soil and groundwater samples that require VOC analysis will be prepared by EPA Method 5030/5035 and analyzed using EPA SW-846 Method 8260B.

3.2.2.2 SVOCs

Soil and groundwater samples that require analysis of SVOCs will be prepared by EPA Method 3520/3550 and be analyzed using EPA SW-846 Method 8270C.

3.2.2.3 Total Lead

Soil samples that require analysis of total lead will be prepared by EPA Method 3010A and will be analyzed using EPA Method 6010B.

3.2.2.4 TPH as GRO/DRO

Soil and groundwater samples that require analysis of TPH as GRO/DRO will be prepared by EPA Method 3550/3510 (DRO) and 5020 (GRO) and will be analyzed using EPA Method 8015B.

3.3 Quality Control Requirements

3.3.1 Field Quality Control Checks

The collection of field duplicates and QA duplicates for laboratory analysis will allow an assessment of field sampling precision and bias. Collection of the field QC samples will be collected at the frequency indicated in Section 2.4.1.2 of this QAPP. Field duplicates will be collected from the same sample interval as the original sample. For groundwater samples, samples will be collected from the same depth and time as the original sample.

3.3.2 Laboratory Quality Control Checks

Laboratory QC checks are detailed in the laboratory QAM (Appendix A). In general, the QC requirements include the following:

- Trip blanks;
- Reagent/preparation/calibration blanks (applicable to inorganic analysis);
- Instrument blanks;
- Initial calibration;
- Initial calibration verification;
- Continuing calibration verification;
- Method RL verification;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates;
- LCS samples;
- Internal standard areas for Gas Chromatograph/Mass Spectrometer (GC/MS) analysis; and
- Mass tuning for GC/MS analysis.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. The laboratory will re-analyze any samples analyzed in non-conformance with the QC

criteria, if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for re-analysis when necessary. Data packages will be available in electronic form.

3.3.3 Level of Quality Control Effort

The general level of the QC effort will be one field duplicate for every 10 investigative samples and one MS/MSD for every 20 investigative samples. A trip blank will be included with each cooler containing samples selected for volatiles analysis.

In addition to the QC parameters identified above, the laboratory analyzes additional QC samples as part of the analytical method as detailed in the laboratory QAM (Appendix A).

3.4 Instrument/ Equipment Testing, Inspection and Maintenance

To ensure that all analytical data generated for this project are reliable, all equipment and instruments will have a prescribed routine maintenance schedule in addition to a calibration schedule. Preventive maintenance will be completed and documented by qualified personnel.

3.4.1 Field Instrument Preventive Maintenance

The field equipment for this project may include PIDs, and a multi-parameter probe for the analysis of pH, DO, ORP, temperature and specific conductance. Specific preventative maintenance procedures to be followed for field equipment are based on those recommended by the manufacturer. Backup instruments and equipment will be available within one-day shipment to avoid delays in the field schedule.

3.4.2 Laboratory Instrument Preventive Maintenance

As part of the QAM, the laboratory conducts a routine preventative maintenance program to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All maintenance that is performed is documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturer's specifications. The frequency of laboratory preventive maintenance is identified in the laboratory QAM (Appendix A).

3.5 Instrument Calibration and Frequency

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

3.5.1 Field Instrument Calibration

The field instruments will be calibrated as described in the manufacturer's manual. In general, instruments will be calibration checked at the beginning of each day and calibrated weekly.

All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, temperature at which readings were taken and the readings. Multiple readings on one sample or standard, as well as readings on replicate samples, will likewise be documented.

3.5.2 Laboratory Instrument Calibration

All laboratory instrumentation will be calibrated in accordance with the respective analytical method. In general, calibration procedures for a specific laboratory instrument will consist of initial calibrations (three or five points), initial calibration verifications and continuing calibration verification.

The laboratory maintains a sample logbook for each instrument, which will contain the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions run, and the samples associated with these calibrations.

3.6 Inspection Requirements for Supplies and Consumables

The Site Manager is responsible for ensuring that all consumable materials and ancillary sampling equipment is adequate for its intended use, compatible with other equipment and free of defects. An inspection of all field supplies should be conducted prior to field activities.

3.7 Non-direct Measurements

Historical data collected as part of previous investigations at the site may be utilized, along with data collected based on this QAPP, to achieve the project objective. Historic data incorporated into the decision making process will be discussed with the EPA.

3.8 Data Reduction

All data generated through field activities or by the laboratory operation, will be reduced and validated prior to reporting.

4 ASSESSMENT AND OVERSIGHT

A field audit may be conducted to verify that sampling is performed in accordance with the procedures established in the QAPP and in the SOPs (Appendix C). A performance and system audit of the laboratory may be conducted to verify analyses are completed as identified in the QAM (Appendix A). The audits of field and laboratory activities include two independent parts: internal and external audits.

4.1 Field Performance and System Audits

4.1.1 Internal Field Audits

Internal audits of field activities, including sampling and field measurements, can be conducted prior to, at the start of, or at any time during field sampling activities by the QAO or the QAO's assigned designee. These audits will verify that all established procedures are being followed. The audit will be completed at the beginning of the project and will include a review of all field activities completed at that time.

Internal field audits will be conducted at least once at the beginning of the site sample collection activities. If warranted, additional field audits may be completed.

The audits will include but not be limited to examination of the following:

- Field sampling records;
- Field screening analytical results;
- Field instrument operating records, sample collection, handling and packaging in compliance with the established procedures;
- Maintenance of QA procedures; and
- CoC procedures.

Follow-up audits may be required to correct deficiencies and to verify that QA procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The QAO will issue an audit report to the Project Manager. Non-conformances will be addressed and resolved by the Project Manager.

4.1.2 External Field Audits

If performed, external field audits may be conducted prior to, at the start of, or at any time during field sampling activities. These audits may or may not be announced.

External field audits will be conducted according to the field activity information presented in the procedures in the SOPs (Appendix C). The QAO will issue an audit report to the Project Manager. Non-conformances will be addressed and resolved by the Project Manager.

4.1.3 System Audits

Performance and system audits may be conducted to verify documentation and implementation of the QA program, assess the effectiveness of the work plan, identify any non-conformances and verify corrective action of identified deficiencies. Repeated failure or gross irregularities in field duplicate, QA split, and/or calibration or quality control samples may warrant the need for an audit.

The QAO may conduct a system audit of the fieldwork performance. The Site Manager is responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of work is adequate and complete. The Site Manager is responsible for overseeing that the project field team follows the field procedures set forth in the SOPs. Reports and technical correspondence will be peer reviewed and senior reviewed by assigned qualified individuals, otherwise external to the project, before being finalized.

4.1.4 Audit Records

If an audit is completed, the original records generated for all audits will be retained within the central project files. Records will include audit reports, written replies, the record of completion of corrective actions and documents associated with the conduct of audits, which support audit findings and corrective actions as appropriate.

4.2 Laboratory Performance and Systems Audits

4.2.1 Performance Audits

Performance audits are used to quantitatively assess the accuracy of measurement data through the use of performance evaluation and blind check samples. The performance audit, if needed, will be performed by the QAO or QAO's assigned designee in accordance with documented procedures. Performance audits of the laboratory are performed in accordance with the procedures and frequencies established for SW-846 and SDWA methodologies. The QAO will evaluate the need for additional performance audits with due consideration given to the recommendations of the Project Manager.

4.2.2 Internal Laboratory Audits

4.2.2.1 Internal Laboratory Audit Responsibilities

If performed during this project, the QAO or QAOs assigned designee will conduct the internal laboratory audit prior to, at the start of, or at any time during field sampling activities.

4.2.2.2 Internal Laboratory Audit Frequency

The internal laboratory system audits and internal performance audits will be conducted on an annual basis.

4.2.2.3 Internal Laboratory Audit Procedures

The internal system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, CoC procedures, sample preparation and analysis, instrument operating records, etc. The performance audits, if performed, will involve preparing blind QC samples and submitting them, along with project samples, to the laboratory for analysis throughout the project. The QAO or QAOs assigned designee, will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. If the laboratory fails the QC sample analysis, they will be given another opportunity for blind QC sample analysis. A second failure will be cause for termination of the laboratory from the project.

4.2.3 External Laboratory Audits

4.2.3.1 External Laboratory Audit Responsibilities

As part of BP's contract laboratory program, third party audits are completed annually. Additionally, an external audit may be conducted, as required, by the QAO or QAO's assigned designee.

4.2.3.2 External Laboratory Audit Frequency

In addition to BP's annual audits, an audit may be requested if repeated failure or gross irregularities are observed in the field duplicate, QA split, calibration or quality control samples.

4.2.3.3 Overview of the External Laboratory Audit Process

External audits may include review of laboratory analytical procedures, laboratory on-site visits and/or submission of performance evaluation samples to the laboratory for analysis. Non-conformances will be listed by the QAO or QAO's assigned designee and a report will be issued to the PC and the laboratory. The laboratory will be given a week to address the non-conformances to the satisfaction of the QAO or QAO's assigned designee and the PC. Failure to resolve any or all audit procedures chosen can lead to laboratory disqualification and the requirement that another suitable laboratory be chosen.

An external on-site review can consist of sample receipt procedures, custody, sample security and log in procedures, sample throughput tracking procedure, review of instrument calibration records, instrument logs and statistics (number and type), review of QA procedures, logbooks, sample prep procedures, sample analytical SOP review, instrument (normal or extended

quantitation report) reviews, personnel interviews, review of deadlines and glassware prep and a close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include, but not be limited to, the following:

- Comparison of resulting data to the SOP or method, including coding for deviations;
- Verification of initial and continuing calibrations within control limits;
- Verification of surrogate recoveries and instrument timing results, where applicable;
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable;
- Recoveries on control standard runs;
- Review of run logs with run times, ensuring proper order of runs;
- Review of spike recoveries/QC sample data;
- Review of suspected manually integrated GC/MS data and its cause (where applicable);
- Review of GC/MS peak resolution for isolated compounds as compared to reference spectra (where applicable); and
- Assurance that samples are run within holding times.

An external audit may initiate within the laboratory to review procedures and verify the list above. Data packages may be requested either in hard copy or electronic form to be reviewed on or off the laboratory premises.

4.3 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective actions proposed and implemented will be documented in regular QA reports to management. Corrective action will only be implemented after approval by the PC or PC's assigned designee.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the PC, who in turn will notify the OSC. If the problem is analytical in nature, information on these problems will be promptly communicated to the QAO.

Any non-conformance with respect to the established QC procedures in the QAPP will be identified and corrected in accordance with the QAPP. The PC or PC's assigned designee will issue a non-conformance report for each non-conformance condition.

4.3.1 Field Corrective Action

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the FSP, etc.) or if sampling and/or field analytical procedures require modification due to unexpected conditions. In general, the Site Manager or QAO may identify the need for corrective action. The field staff, in consultation with the Site Manager, will recommend a corrective action. The Project Manager will approve the corrective measure (after consultation with and concurrence by the PC and OSC) that will be implemented by the field team. It will be the responsibility of the Site Manager to ensure the corrective action has been implemented. All corrective actions implemented will be documented in the field logbooks.

4.3.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions (such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples, etc.) may be identified during sample login or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the laboratory Quality Manager to approve the implementation of corrective action. Depending on the condition encountered, the laboratory Quality Manager may consult the QAO for input. Conditions during or after analysis that may automatically trigger corrective action or optional procedures include dilution of samples, additional sample extract cleanup, automatic re-injection/re-analysis when certain QC criteria are not met, etc. A summary of method-specific corrective actions is available in the laboratory QAM (Appendix A). All laboratory corrective actions will be documented and also identified in the case narrative of the data packages.

4.3.3 Corrective Action during Data Review, Verification and Validation

The need for corrective action may be required during the data review, verification or validation. Potential types of corrective action may include re-sampling by the field team or re-extraction/re-analysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team and if the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded). If a corrective action is identified, it is the PC or PC's assigned designee who will be responsible for approving the implementation of corrective action, including re-sampling, during data assessment. All corrective actions of this type will be documented in the project file.

4.4 Quality Assurance Reports to Management

The Project Manager will report to the PC regularly regarding progress of the fieldwork and quality control issues associated with field activities.

The laboratory maintains detailed procedures for laboratory recordkeeping in order to support the validity of all analytical work. Each data set report submitted to the QAO will contain the laboratory's written certification that the requested analytical methods were run and that all QA/QC checks were within established control limits for all samples analyzed.

After receipt of all analytical data, the Project Manager or the Project Manager's designee will submit a Data Review Report for each data set to the QAO describing the accuracy and precision of the data. Verbal reports will be provided following the receipts of individual packages as they are received.

After the fieldwork is complete and the final analyses are completed, reviewed, and validated, a final report will be prepared. The report will summarize the QA and audit information (if completed), indicating any corrective actions taken and the overall results of QAPP compliance. The Site Manager or Site Manager's assigned designee will prepare this final summary and submit this to the QAO for review. The report will be utilized during the decision-making process and will be incorporated as part of the final report.

5 DATA VALIDATION AND USABILITY

5.1 Data Review, Verification and Validation

The field and laboratory procedures described in this QAPP will be reviewed to assess whether these activities were performed in a manner that is appropriate for accomplishing the project objectives. This assessment will include review of data followed by data verification and data validation. Stantec will perform data verification on 100% of laboratory data and perform data validation on 10% of the laboratory data to determine whether the data have been generated in accordance with the procedures identified in the QAPP.

5.1.1 Review of Sampling Design

Data conformation to the sampling design specifications in Section 3.1 will be reviewed by the Site Manager during field activities. Samples that deviate from the sampling design and the impact to project objectives, if any, will be discussed in the final report prepared at the end of the field activities.

5.1.2 Review of Sample Collection Procedures

The sample collection procedures employed by the field sampling team will be reviewed on a routine basis during each field activity to confirm that the samples are collected and analyzed in accordance with Sections 3.1 and 3.2. This review will note unacceptable departures, if any, from sample collection procedures in the QAPP and identify sample data (analytical or field) that should be excluded from incorporation into the project database or data evaluation process. In addition, the Site Manager or Site Manager's assigned designee will review project logbooks or records on a routine basis during sampling activities.

To assure that all field data are collected accurately and correctly, field audit(s) as described in Section 4.1 will be performed during sample collection to document that the appropriate procedures are being followed with respect to sample (and QC sample) collection. These audits will include a thorough review of the field books and standard data collection forms used by the project personnel to ensure that tasks are performed as specified in the QAPP.

The evaluation (data review) of equipment blanks and other field QC samples will provide definitive indications of the data quality. If a problem arises, it should be able to be isolated via the complete sample tracking and documentation procedures that will be performed. If such a problem does arise, corrective action can be instituted and documented. If data are compromised due to a problem, appropriate data qualifications will be used to identify the data.

The labeling and identification of samples will also be reviewed to ensure samples properly represent the location they were intended to represent. It is expected that labeling errors will be

minimal due to use of standardized labeling schemes detailed in Section 3.1.4.6 and Section 3.1.4.7.

5.1.3 Review of Sample Handling

The handling, preservation and storage of samples collected during the sampling program will be monitored on an on-going basis. The field audits described in Section 4.1 will provide documentation on proper handling of samples during collection and processing at the analytical laboratory. These audits will be reviewed by the Project Manager and Site Manager to determine if sample representativeness was maintained during collection and processing. In addition, the project laboratory will document sample receipt including proper containers, preservation and cooler temperature at the time samples are logged into the laboratory's custody. The cooler receipt forms (a required data package deliverable) as well as CoC documentation will be routinely assessed by the data reviewers during data verification/validation. Sample handling, storage or preservation problems identified during data verification/validation will result in appropriate qualification of data to warn the data user to data quality deficiencies.

5.1.4 Review of Analytical Procedures

The use of the proper analytical procedures described in Section 3.2.2 will be reviewed primarily through the data verification and data validation methods discussed in Section 5.1.7. Qualification of data that does not conform to criteria is also discussed in Section 5.1.7.

Confirmation that samples were analyzed for the proper analyses will be performed through review of the laboratory data packages. Review of the data packages will determine if samples submitted for analysis actually had the analyses performed. If analyses that were identified to be performed were not actually performed (due to loss of sample or improper log in at the laboratory, etc.) then a determination should have been made at the time the missing data was discovered and appropriate corrective action documented. The Site Manager or Site Manager's assigned designee will review the impact of incomplete analyses and identify impacts to the project objectives, if any, in the final project report.

5.1.5 Review of Quality Control

The review of quality control checks described in Section 3.3 will be reviewed primarily through the data verification and data validation. Qualification of data that does not conform to criteria is discussed in Section 5.1.7.

5.1.6 Review of Calibration

The review of instrument and equipment calibration described in Section 3.5 will be reviewed primarily through the data verification and data validation. Qualification of data that does not conform to criteria is discussed in Section 5.1.7. The Site Manager or Site Manager's assigned

designee will review records of field equipment calibration and identify any impacts to non-analytical data that may exist.

5.1.7 Data Verification and Validation Methods

Analytical data quality will be verified and validated based on the criteria outlined in Section 2.4. The following sub-sections detail the methods used for validation. Sample analytical results for each matrix will be validated by the Data Validator in accordance with the EPA NFG. All data will be manually validated and qualifiers (data changes or flags) will be added to the database by the Validator or designee. The Validator will then review the data changes and flags against the hardcopy for accuracy.

This data will be the primary source of data for risk and final cleanup evaluation. In the event the data are unacceptable, additional validation may be required.

5.1.8 Precision

Precision is quantitatively expressed in terms of RPD, and is calculated as follows:

$$RPD = [(C_1-C_2) / ((C_1+C_2)/2)] \times 100$$

Where:
RPD = relative percent difference
C_1 = larger concentration of the two duplicate results
C_2 = smaller concentration of the two duplicate results

5.1.9 Accuracy

Accuracy will be evaluated in terms of %R, which is calculated as follows:

$$\%R = [(M_{sa}-M_{ua}) / C_{sa}] \times 100$$

Where:
%R = percent recovery
M_{sa} = measured concentration in spiked aliquot
M_{ua} = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

5.1.10 Completeness

Completeness will be calculated as follows:

$$C = (\text{Number of Valid Measurements}) / (\text{Total Number of Measurements}) \times 100$$

Where:
C = completeness

5.1.11 Data Reconciliation

The QAO will determine whether field and analytical data or data sets meet the requirements necessary for decision making. The results of measurements will be compared to the DQI requirements set forth Section 2.4. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. Data generated by the sampling activities will be used to develop tables and graphic representations of the vertical and horizontal distribution of impacts in soil and groundwater. The DQOs will be considered to be satisfied if the data are sufficient (based on the quality of the data) to complete the characterization of subsurface materials to help delineate the presence or absence of gasoline-related constituents at the former Standard Oil Bulk Plant. Data that do not meet the data criteria (if any) will be identified and appropriately noted in the project database. The QAO will make a determination on the usability of data that do not meet the criteria.

Figures

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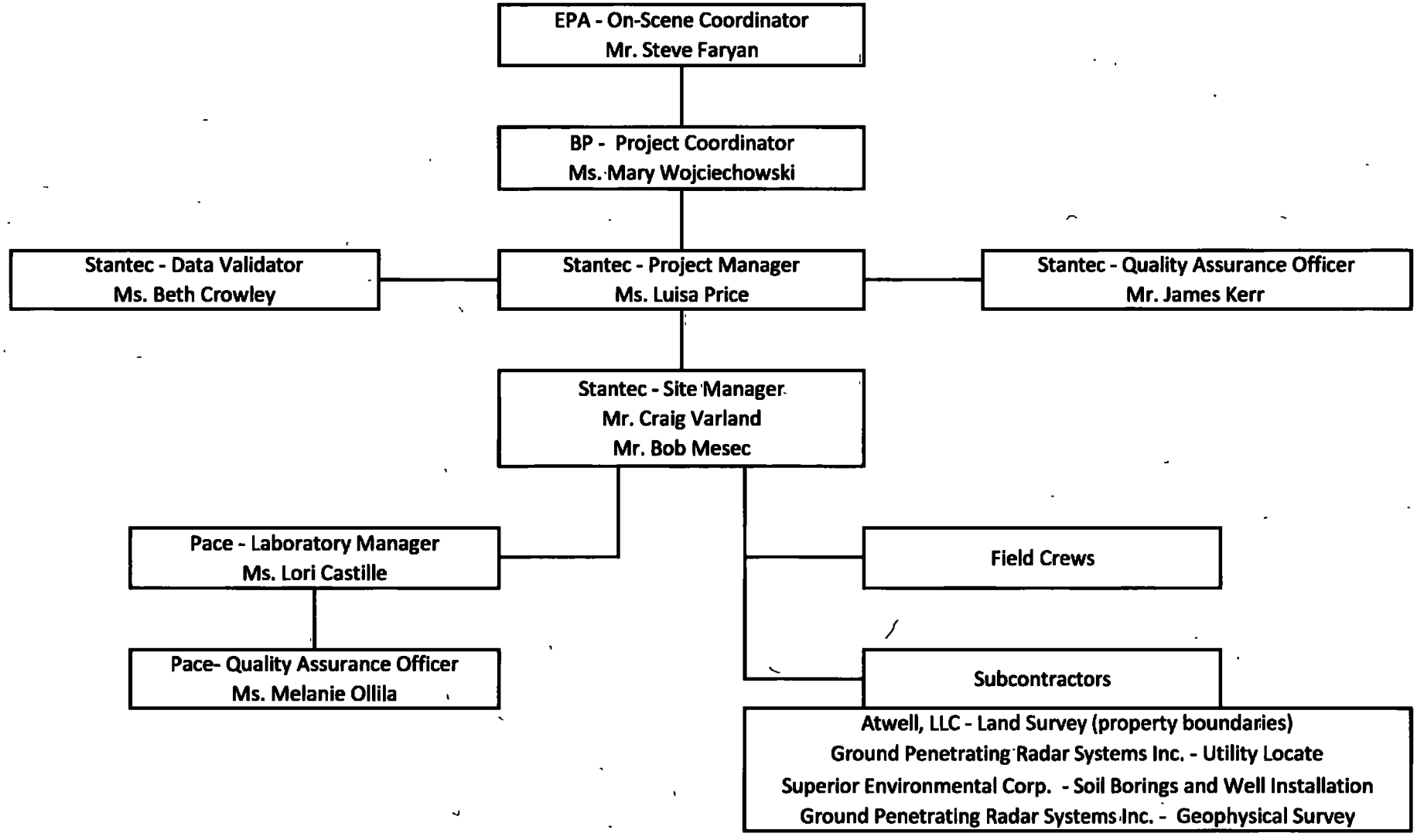
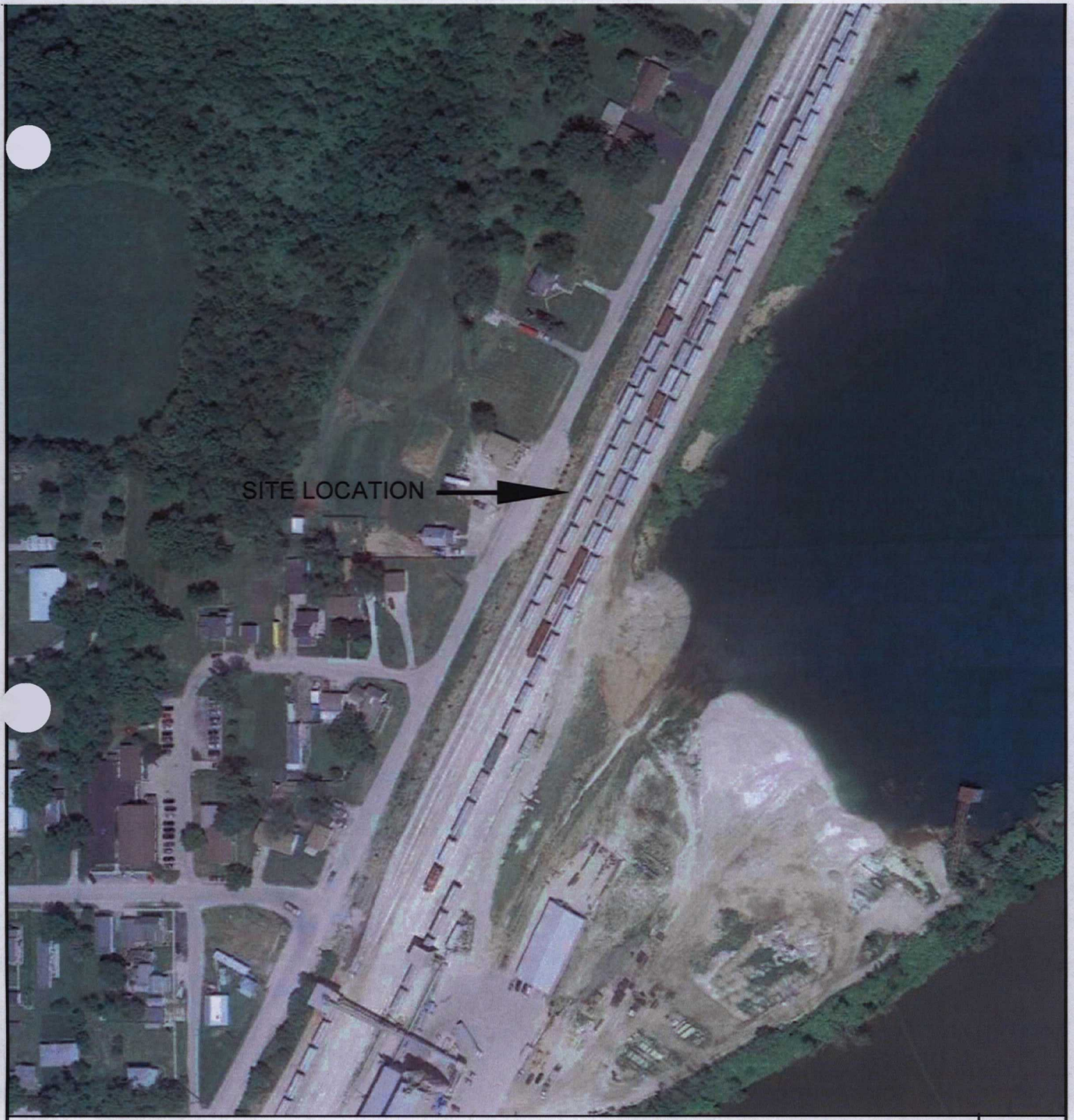
FIGURES

Quality Assurance Project Plan
Site Investigation
BP Products North America, Inc. Site # 5482

Figure 1
Project Organization Chart
Quality Assurance Project Plan
Site Investigation
BP Site # 5482 - Former Standard Oil Bulk Plant
Wedron, La Salle County, Illinois
Stantec Project No.:182630000





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APPROXIMATE SCALE (FEET)

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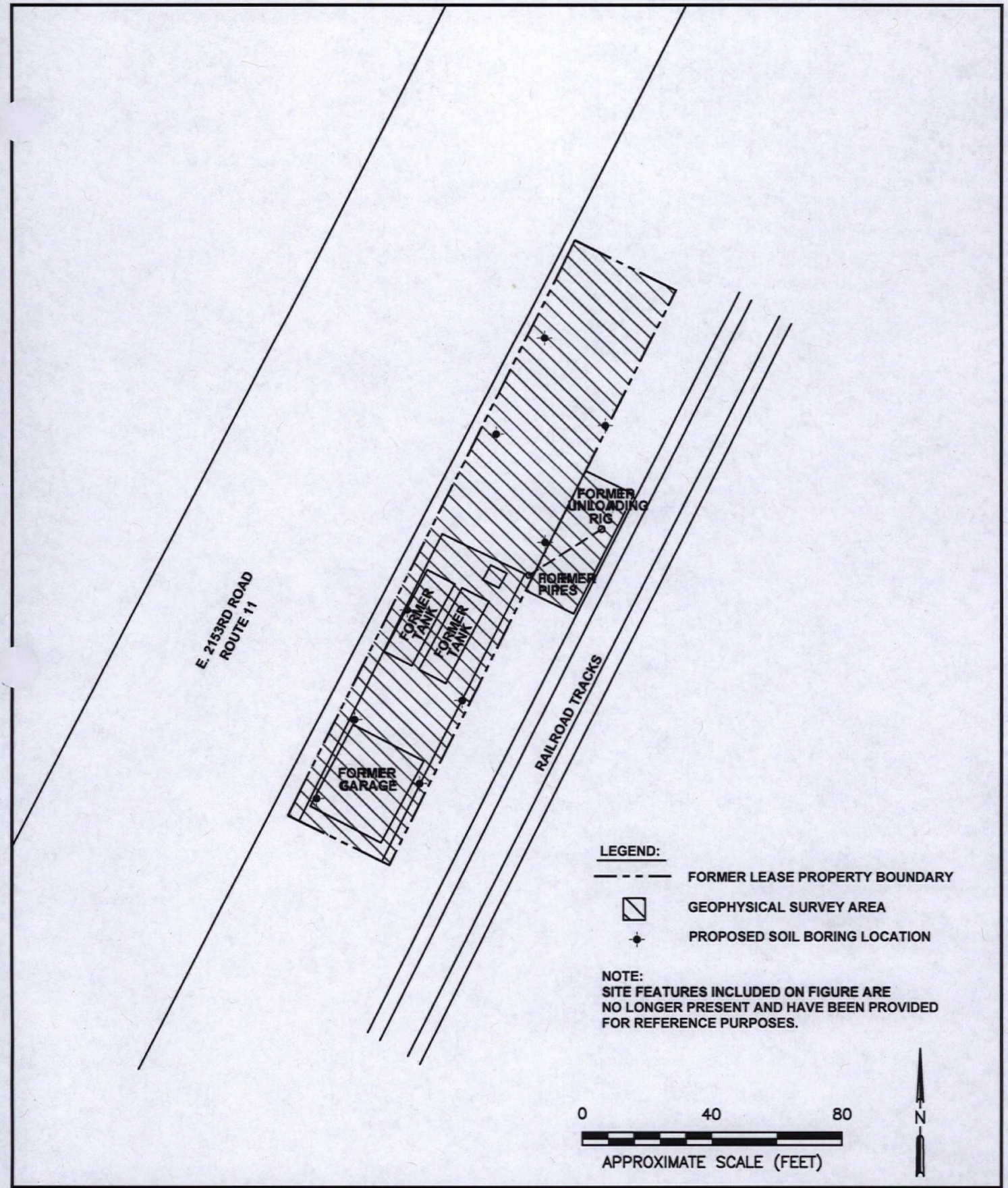
SITE LOCATION MAP
BP SITE #5482
FORMER BULK PLANT
WEDRON, ILLINOIS

FIGURE: **2**

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
182630000	KM	AG	LP	08/21/13



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GEOPHYSICAL SURVEY & PROPOSED SOIL BORING LOCATION MAP
BP SITE #5402 FORMER BULK PLANT
WEDRON, ILLINOIS

FIGURE: **3**

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
	KM	LP	AG	12/05/13

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Tables

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TABLES

Quality Assurance Project Plan
Site Investigation
BP Products North America, Inc. Site # 5482

Ta 1

Data Validation and Acceptance Criteria
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Holding Time	Each sample should meet holding times. Holding times are presented in Table 2 and Table 3 of the QAPP	Analytical results from samples which exceed the holding times will be flagged as estimated concentrations (J) for detected results and unusable (R) for non-detect results.
Trip and Equipment Blanks	Contaminants are not present in the blanks.	Flag values as estimated (J) if less than 10X for method-specific laboratory contaminants and 5X for other contaminants. Flag values as (B) if the analyte was detected in the blank sample. Request that laboratory review data. Carefully consider type of blank, compounds present, and origin of contaminants. Modify sampling procedures or laboratory SOPs.
Field Duplicates	RPD for water = 25%, for solids = 50%.	Flag values as estimated (J) if the RPD for duplicate pairs that exceed the criteria. Review sampling procedures and request that laboratory review data.

Ta l

Data Validation and Acceptance Criteria
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Reporitng Limit	If dilution is required as a result of matrix interference, the reporting limits will be adjusted by the laboratory and the lowest reporitng limit may not be achievable.	Concentrations reported below the reporting limit will be flagged as estimated (J). Review sensitivity data and discuss specific results with testing laboratory in a qualitative manner to determine if re-analysis or modification of procedures should be performed to meet desired objectives.
Matrix Spike/Matrix Spike Duplicate	RPD for water = 20%, for solids = 20%. %R values provided in Table 4 and Table 5	Data are not qualified based on MS/MSD results alone. Verify that the associated LCS is within QC limits.
Surrogates	%R values provided in Table 4 and Table 5	Samples with surrogate recoveries below QC limits will be flagged as estimated (J) for detected results and R for nondetects. Samples with surrogate recoveries above QC limits will be flagged as estimated (J) for detected results. Nondetects will not be qualified. In all cases, qualification of the data is at the discretion of the data validator, i.e., where dilutions are involved, the validator may determine that data qualifications are not necessary.
Laboratory Control Sample	%R values provided in Table 4 and Table 5	Review data and discuss with laboratory. Re-analysis may be necessary. Data qualifications may be necessary at the discretion of the data validator.

Ta l

Data Validation and Acceptance Criteria
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Initial Calibration	Organics - % RSD is less than 30 for calibration check compounds and less than 15 for other analytes.	Laboratory should recalibrate instrument. Samples run on ICAL which is out of QC limits are qualified as estimated (J) for detected results and (UJ) for nondetects.
Continuing Calibration Verification	Organics - % D is less than 20% for calibration check compounds.	Calibration standard should be re-injected. A new calibration curve should be run if re-injection fails. Analyses associated with the CCAL will be qualified as estimated (J) for detected results and (UJ) for nondetects.
General Quality of Data	Completeness of data should range between 90 and 100% complete.	Review completeness data and discuss results with testing laboratory in a qualitative manner to determine if re-analysis or modification of procedures should be performed to meet desired objectives.

Note: Table 1 is to be used for data validation for each validation point, where applicable. Specific determinations of data validity should be based on review of the data and circumstances associated with the samples tested in accordance with National Functional Guidelines for Inorganic and Organic Data Review (2008/2010).

Data Validation Qualifiers

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is an estimated quantity.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a 'tentative identification.'
NJ	The analysis indicates the presence of an analyte that has been 'tentatively identified' and the associated numerical value is an estimated quantity.
UJ	The analyte was not detected above the reported sample quantitation limit. The associated quantitation limit is estimated.
B	The analyte was detected in the method, field and/or trip blank.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

TABLE 2
Soil Sample Field QC Frequency, Sample Volumes, Preservatives, and Holding Times
Quality Assurance Project Plan
Site Investigation
BP Site #5482 – Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Analytical Parameter Method	Preservation	Number/ Minimum Volume/Type of Container	Sample Hold Time (from collection)	Field QC Sample Frequency[1]				
				Equipment Blanks[2]	Field Duplicate	Field Blanks	Trip Blanks	MS/MSD
Soil/Waste/Fill Material								
Total Lead/EPA 6010B	Cool to 6°C	1 – 8 ounce plastic or glass	6 months	1 per 10	1 per 10	N/A	N/A	1 per 20
Volatile Organic Compounds/EPA 8260B	Cool to 6°C	Terra Core 1 – 40 mL Vial with Methanol 2– 40 mL Vial DI Water	14 days	1 per 10	1 per 10	1 per 10	1 per shipment	1 per 20
Percent Moisture/as described in EPA 3550B	None	1 – 4 ounce plastic or glass	Analyze as soon as possible	N/A	1 per 10	N/A	N/A	N/A
Semi-volatile Organic Compounds/EPA 8270C	Cool to 6°C	1 – 4 ounce amber glass	14 days for extraction 40 days after extraction	1 per 10	1 per 10	N/A	N/A	1 per 20
Petroleum Hydrocarbons/Diesel Range Organics/EPA 8015B	Cool to 6°C	2 – 4 ounce amber glass	14 days for extraction 40 days after extraction	1 per 10	1 per 10	N/A	N/A	1 per 20
Gasoline Range Organics/EPA 8015B	Cool to 6°C	Terra Core 1 – 40 mL Vial with Methanol 2– 40 mL Vial DI Water	14 days	1 per 10	1 per 10	1 per 10	1 per shipment	1 per 20

Definitions:

[1] A sufficient sample shall be collected to meet this project's requirement of 1 per 20 MS/MSD QA/QC samples. Ensuring that these requirements are met is the responsibility of Stantec.

[2] This frequency is per activity, not per sample collection (i.e. per soil boring location, not number of samples collected from the boring).

TABLE 3
Groundwater Sample Field QC Frequency, Sample Volumes, Preservatives, and Holding Times
Quality Assurance Project Plan
Site Investigation
BP Site #5482 – Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Analytical Parameter Method	Preservation	Number/ Minimum Volume of Container	Sample Hold Time (from collection)	Field QC Sample Frequency[1]				
				Equipment Blanks[2]	Field Duplicate	Field Blanks	Trip Blanks	MS/MSD
Water								
Volatile Organic Compounds EPA/8260B	VOCs – HCL and cool to 6°C;	3 – 40 ml VOA vials (VOAs)	14 days	1 per 10	1 per 10	1 per 10	1 per trip	1 per 20.
Total Petroleum Hydrocarbons as Gasoline Range Organics /EPA 8015B	Cool to 6°C	2 – 40 ml VOA vials	14 days	1 per 10	1 per 10	N/A	N/A	1 per 20
Total Petroleum Hydrocarbons as Diesel Range Organics /EPA 8015B	Cool to 6°C	1 – 1 liter amber glass	7 days for extraction 40 days after extraction	1 per 10	1 per 10	N/A	N/A	1 per 20
Semi-volatile Organic Compounds /EPA 8270C	Cool to 6°C	1 – 1 liter amber glass	7 days for extraction 40 days after extraction	1 per 10	1 per 10	N/A	N/A	1 per 20

Definitions:

[1] A sufficient sample shall be collected to meet this project's requirement of 1 per 20 MS/MSD QA/QC samples. Ensuring that these requirements are met is the responsibility of Stantec.
[2] This frequency is per activity, not per sample collection (i.e. per soil boring location, not number of samples collected from the boring).

Table 4
Laboratory Accuracy and Precision Limits - Soil
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Soil				
	MDL	RL	LCS	MS/MSD	
	mg/kg	mg/kg	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Method 8260B					
1,1,1,2-Tetrachloroethane	0.0250	0.05	72-125	75-134	30
1,1,1-Trichloroethane	0.0033	0.05	72-125	71-141	30
1,1,2,2-Tetrachloroethane	0.0065	0.05	73-125	66-137	30
1,1,2-Trichloroethane	0.0045	0.05	75-125	68-139	30
1,1,2-Trichlorotrifluoroethane	0.0250	0.05	65-127	59-153	30
1,1-Dichloroethane	0.0041	0.05	73-125	72-138	30
1,1-Dichloroethene	0.0071	0.05	68-125	59-143	30
1,1-Dichloropropene	0.0064	0.05	71-125	68-143	30
1,2,3-Trichlorobenzene	0.0200	0.05	66-125	65-137	30
1,2,3-Trichloropropane	0.0147	0.2	72-125	74-133	30
1,2,4-Trichlorobenzene	0.0200	0.05	69-125	66-138	30
1,2,4-Trimethylbenzene	0.0250	0.05	74-125	74-135	30
1,2-Dibromo-3-chloropropane	0.0730	0.5	65-125	67-137	30
1,2-Dibromoethane (EDB)	0.0054	0.05	75-125	76-130	30
1,2-Dichlorobenzene	0.0250	0.05	74-125	73-134	30
1,2-Dichloroethane	0.0067	0.05	72-125	66-138	30
1,2-Dichloropropane	0.0059	0.05	74-125	74-135	30
1,3,5-Trimethylbenzene	0.0250	0.05	73-125	71-139	30
1,3-Dichlorobenzene	0.0250	0.05	74-125	72-134	30
1,3-Dichloropropane	0.0250	0.05	75-125	75-131	30
1,4-Dichlorobenzene	0.0250	0.05	75-125	73-133	30
2,2-Dichloropropane	0.0493	0.2	62-135	52-153	30
2-Butanone (MEK)	0.1250	0.25	58-126	59-138	30
4-Chlorotoluene	0.0250	0.05	74-125	73-134	30
4-Methyl-2-pentanone (MIBK)	0.1250	0.25	66-125	69-136	30
Acetone	0.5000	1	63-128	63-142	30
Allyl chloride	0.0088	0.2	66-132	64-143	30
Benzene	0.0100	0.02	72-125	71-137	30
Bromobenzene	0.0059	0.05	74-125	75-133	30
Bromochloromethane	0.0102	0.05	72-125	67-139	30
Bromodichloromethane	0.0064	0.05	72-125	72-138	30
Bromoform	0.1000	0.2	63-125	71-132	30
Bromomethane	0.2500	0.5	58-125	56-134	30
Carbon tetrachloride	0.0050	0.05	66-125	64-146	30
Chlorobenzene	0.0037	0.05	75-125	75-131	30
Chloroethane	0.0125	0.5	67-125	50-146	30
Chloroform	0.0076	0.05	73-125	72-137	30
Chloromethane	0.0152	0.2	60-125	54-123	30
cis-1,2-Dichloroethene	0.0082	0.05	73-125	70-136	30
cis-1,3-Dichloropropene	0.0039	0.05	73-125	71-137	30

Table 4
Laboratory Accuracy and Precision Limits - Soil
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Soil				
	MDL	RL	LCS	MS/MSD	
	mg/kg	mg/kg	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Dibromochloromethane	0.0064	0.05	69-125	69-137	30
Dibromomethane	0.0078	0.05	75-125	73-135	30
Dichlorodifluoromethane	0.0152	0.05	44-125	30-128	30
Dichlorofluoromethane	0.0410	0.5	67-142	47-150	30
Diethyl ether (Ethyl ether)	0.0112	0.2	69-125	62-138	30
Ethylbenzene	0.0200	0.05	75-125	75-134	30
Hexachloro-1,3-butadiene	0.1250	0.25	62-126	54-150	30
Isopropylbenzene (Cumene)	0.0250	0.05	74-125	75-136	30
m-Xylene (coelute) p-Xylene	0.0400	0.1	75-125	75-134	30
Methyl-tert-butyl ether	0.0250	0.05	71-125	65-140	30
Methylene Chloride	0.1000	0.2	72-125	66-136	30
Naphthalene	0.1000	0.2	69-125	67-138	30
Styrene	0.0041	0.05	74-125	67-139	30
Tetrachloroethene	0.0066	0.05	73-125	72-138	30
Tetrahydrofuran	0.0603	2	65-125	62-139	30
Toluene	0.0200	0.05	75-125	74-133	30
Trichloroethene	0.0076	0.05	74-125	72-142	30
Trichlorofluoromethane	0.0092	0.2	64-125	53-146	30
Vinyl chloride	0.0080	0.02	65-125	46-135	30
Xylene (Total)	0.0600	0.15	75-125	75-135	30
n-Butylbenzene	0.0200	0.05	70-125	69-141	30
n-Propylbenzene	0.0200	0.05	74-125	71-140	30
o-Xylene	0.0200	0.05	75-125	75-135	30
p-Isopropyltoluene	0.0200	0.05	70-125	65-144	30
sec-Butylbenzene	0.0200	0.05	71-125	63-146	30
tert-Butylbenzene	0.0200	0.05	71-125	71-137	30
trans-1,3-Dichloropropene	0.0049	0.05	71-125	72-135	30
trans-1,2-Dichloroethene	0.0061	0.05	75-125	66-140	30
1,2-Dichloroethane-d4(surr)			57-150	NA	NA
4-Bromofluorobenzene(surr)			67-138	NA	NA
Toluene-d8(surr)			70-136	NA	NA

Table 4
Laboratory Accuracy and Precision Limits - Soil
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Soil				
	MDL	RL	LCS	MS/MSD	
	mg/kg	mg/kg	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Method 8270C					
1,2,4-Trichlorobenzene	0.0438	0.3300	33-125	49-125	30
1,2-Dichlorobenzene	0.0516	0.3300	30-125	42-125	30
1,2-Diphenylhydrazine	0.0741	0.3300	52-125	54-125	30
1,3-Dichlorobenzene	0.0471	0.3300	30-125	39-125	30
1,4-Dichlorobenzene	0.0437	0.3300	30-125	40-125	30
1-Methylnaphthalene	0.0403	0.3300	42-125	51-125	30
2,4,5-Trichlorophenol	0.0353	0.3300	51-125	50-125	30
2,4,6-Trichlorophenol	0.0315	0.3300	49-125	53-125	30
2,4-Dichlorophenol	0.0398	0.3300	45-125	52-125	30
2,4-Dimethylphenol	0.1445	0.3300	41-125	50-125	30
2,4-Dinitrophenol	0.0445	0.3300	30-125	30-125	30
2,4-Dinitrotoluene	0.0311	0.3300	51-125	39-125	30
2,6-Dinitrotoluene	0.0351	0.3300	51-125	45-125	30
2-Chloronaphthalene	0.0373	0.3300	47-125	55-125	30
2-Chlorophenol	0.0453	0.3300	34-125	47-125	30
2-Methylnaphthalene	0.0379	0.3300	42-125	52-125	30
2-Methylphenol(o-Cresol)	0.0502	0.3300	40-125	53-125	30
2-Nitroaniline	0.0676	0.3300	48-125	45-125	30
2-Nitrophenol	0.0516	0.6600	36-125	36-125	30
3&4-Methylphenol	0.0362	0.3300	45-125	53-125	30
3,3'-Dichlorobenzidine	0.1591	0.3300	33-125	30-125	30
3-Nitroaniline	0.1100	1.7000	41-125	37-125	30
4,6-Dinitro-2-methylphenol	0.0610	0.3300	30-131	30-125	30
4-Bromophenylphenylether	0.0715	0.3300	52-125	57-125	30
4-Chloro-3-methylphenol	0.0357	0.3300	50-125	52-125	30
4-Chloroaniline	0.0853	0.3300	30-125	30-125	30
4-Chlorophenylphenylether	0.0314	0.3300	50-125	55-125	30
4-Nitroaniline	0.0906	0.3300	45-125	41-125	30
4-Nitrophenol	0.0570	0.3300	41-125	43-125	30
Acenaphthene	0.0319	0.3300	48-125	51-125	30
Acenaphthylene	0.0415	0.3300	48-125	54-125	30
Anthracene	0.0733	0.3300	53-125	51-125	30
Benzo(a)anthracene	0.0780	0.3300	54-125	54-125	30
Benzo(a)pyrene	0.0753	0.3300	51-125	53-125	30
Benzo(b)fluoranthene	0.0843	0.3300	49-125	51-125	30
Benzo(g,h,i)perylene	0.0710	0.3300	62-125	43-125	30
Benzo(k)fluoranthene	0.0802	0.3300	54-125	51-125	30
Butylbenzylphthalate	0.0769	0.3300	49-125	49-125	30
Carbazole	0.0774	0.3300	52-125	55-125	30
Chrysene	0.0812	0.3300	55-125	53-125	30

Table 4
Laboratory Accuracy and Precision Limits - Soil
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Soil				
	MDL	RL	LCS	MS/MSD	
	mg/kg	mg/kg	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Di-n-butylphthalate	0.0670	0.3300	54-125	56-125	30
Di-n-octylphthalate	0.0778	0.3300	48-125	48-125	30
Dibenz(a,h)anthracene	0.0740	0.3300	52-125	52-125	30
Dibenzofuran	0.0271	0.3300	50-125	55-125	30
Diethylphthalate	0.0773	0.3000	52-125	57-125	30
Dimethylphthalate	0.0735	0.3300	52-125	56-125	30
Fluoranthene	0.0755	0.3300	52-125	51-125	30
Fluorene	0.0259	0.3300	51-125	54-125	30
Hexachloro-1,3-butadiene	0.0422	0.3300	30-125	45-125	30
Hexachlorobenzene	0.0782	0.3300	51-125	53-125	30
Hexachloroethane	0.0531	0.3300	30-125	30-125	30
Indeno(1,2,3-cd)pyrene	0.0720	0.3300	52-125	46-125	30
Isophorone	0.0426	0.3300	43-125	50-125	30
N-Nitroso-di-n-propylamine	0.0516	0.3300	39-125	30-125	30
N-Nitrosodimethylamine	0.0789	0.3300	30-127	30-125	30
N-Nitrosodiphenylamine	0.0794	0.3300	53-125	54-125	30
Naphthalene	0.0494	0.3300	36-125	48-125	30
Nitrobenzene	0.0554	0.6700	35-125	48-125	30
Pentachlorophenol	0.0513	0.3300	38-125	30-125	30
Phenanthrene	0.0772	0.3300	53-125	53-125	30
Phenol	0.0435	0.3300	36-125	50-125	30
Pyrene	0.0810	0.3300	51-125	49-125	30
bis(2-Chloroethoxy)methane	0.0439	0.3300	42-125	49-125	30
bis(2-Chloroethyl) ether	0.0500	0.3300	30-125	39-125	30
bis(2-Chloroisopropyl)ether	0.0510	0.3300	30-131	36-125	30
bis(2-Ethylhexyl)phthalate	0.0826	0.0000	50-125	46-125	30
2,4,6-Tribromophenol (surr)			46-125	NA	NA
2-Fluorobiphenyl (surr)			42-125	NA	NA
2-Fluorophenol (surr)			30-127	NA	NA
Nitrobenzene-d5 (surr)			30-127	NA	NA
Phenol-d6 (surr)			30-125	NA	NA
Terphenyl-d14 (surr)			51-125	NA	NA
Method 6010B					
Lead	0.072	1	80-120	75-125	30
Method 8015B					
GRO	2.5	5	75-132	30-150	20
a,a,a-Trifluorotoluene (surr)			80-139	NA	NA
Method 8015B					
DRO (C10 - C28)	3.2	10	61-125	30-149	30
DRO (C24 - C36)	1.8	10	61-125	30-149	30
n-Pentacosane (surr)			41-126	NA	NA

NA: not applicable
surr: surrogate

Table 5
Laboratory Accuracy and Precision Limits - Groundwater
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Water				
	MDL	RL	LCS limits	MS/MSD	
	mg/L	mg/L	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Method 8260B					
1,1,1,2-Tetrachloroethane	0.0005	0.0010	75-125	75-125	30
1,1,1-Trichloroethane	0.0005	0.0010	75-126	75-136	30
1,1,2,2-Tetrachloroethane	0.0001	0.0010	75-125	66-131	30
1,1,2-Trichloroethane	0.0002	0.0010	75-125	75-125	30
1,1,2-Trichlorotrifluoroethane	0.0003	0.0010	51-139	75-150	30
1,1-Dichloroethane	0.0005	0.0010	75-125	75-131	30
1,1-Dichloroethene	0.0002	0.0010	71-126	75-138	30
1,1-Dichloropropene	0.0002	0.0010	74-125	75-136	30
1,2,3-Trichlorobenzene	0.0005	0.0010	75-125	75-125	30
1,2,3-Trichloropropane	0.0005	0.0040	75-125	71-126	30
1,2,4-Trichlorobenzene	0.0005	0.0010	75-125	75-125	30
1,2,4-Trimethylbenzene	0.0005	0.0010	75-125	70-126	30
1,2-Dibromo-3-chloropropane	0.0020	0.0040	73-125	69-127	30
1,2-Dibromoethane (EDB)	0.0002	0.0010	75-125	75-125	30
1,2-Dichlorobenzene	0.0001	0.0010	75-125	75-125	30
1,2-Dichloroethane	0.0002	0.0010	74-125	74-128	30
1,2-Dichloropropane	0.0002	0.0040	75-125	75-125	30
1,3,5-Trimethylbenzene	0.0005	0.0010	75-125	72-126	30
1,3-Dichlorobenzene	0.0005	0.0010	75-125	75-125	30
1,3-Dichloropropane	0.0005	0.0010	75-125	75-125	30
1,4-Dichlorobenzene	0.0005	0.0010	75-125	75-125	30
2,2-Dichloropropane	0.0005	0.0040	67-132	71-143	30
2-Butanone (MEK)	0.0025	0.0050	68-126	64-125	30
2-Chlorotoluene	0.0005	0.0010	74-125	74-125	30
4-Chlorotoluene	0.0002	0.0010	74-125	75-125	30
4-Methyl-2-pentanone (MIBK)	0.0025	0.0050	72-125	69-125	30
Acetone	0.0100	0.0200	69-132	57-135	30
Allyl chloride	0.0002	0.0040	74-125	73-134	30
Benzene	0.0002	0.0010	75-125	70-135	30
Bromobenzene	0.0002	0.0010	75-125	75-125	30
Bromochloromethane	0.0005	0.0010	75-125	75-125	30
Bromodichloromethane	0.0002	0.0010	75-125	75-125	30
Bromoform	0.0020	0.0040	75-126	68-133	30
Bromomethane	0.0020	0.0040	30-150	56-150	30
Carbon tetrachloride	0.0003	0.0010	74-127	75-137	30
Chlorobenzene	0.0002	0.0010	75-125	75-125	30
Chloroethane	0.0005	0.0010	68-132	64-150	30
Chloroform	0.0003	0.0010	75-125	75-127	30
Chloromethane	0.0020	0.0040	61-129	65-140	30
cis-1,2-Dichloroethene	0.0002	0.0010	75-125	75-129	30
cis-1,3-Dichloropropene	0.0005	0.0040	75-125	75-125	30

Table 5
Laboratory Accuracy and Precision Limits - Groundwater
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Water				
	MDL	RL	LCS limits	MS/MSD	
	mg/L	mg/L	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Dibromochloromethane	0.0003	0.0010	75-125	75-125	30
Dibromomethane	0.0004	0.0040	75-125	75-125	30
Dichlorodifluoromethane	0.0004	0.0010	49-137	70-150	30
Dichlorofluoromethane	0.0002	0.0010	66-133	69-142	30
Diethyl ether (Ethyl ether)	0.0020	0.0040	75-125	75-125	30
Ethylbenzene	0.0002	0.0010	75-125	75-125	30
Hexachloro-1,3-butadiene	0.0005	0.0010	69-127	75-135	30
Isopropylbenzene (Cumene)	0.0005	0.0010	75-125	75-125	30
Methyl-tert-butyl ether	0.0005	0.0010	74-126	70-132	30
Methylene Chloride	0.0020	0.0040	75-125	73-125	30
Naphthalene	0.0020	0.0040	75-125	73-126	30
Styrene	0.0002	0.0010	75-125	52-137	30
Tetrachloroethene	0.0003	0.0010	75-125	75-130	30
Tetrahydrofuran	0.0029	0.0100	71-125	69-125	30
Toluene	0.0002	0.0010	75-125	75-125	30
Trichloroethene	0.0001	0.0004	75-125	75-129	30
Trichlorofluoromethane	0.0001	0.0010	69-129	75-150	30
Vinyl chloride	0.0001	0.0004	70-128	75-147	30
Xylene (Total)	0.0007	0.0030	75-125	75-125	30
m-Xylene (coelute) p-Xylene	0.0005	0.0020	75-125	75-125	30
n-Butylbenzene	0.0005	0.0010	72-126	75-130	30
n-Propylbenzene	0.0005	0.0010	73-125	75-128	30
o-Xylene	0.0002	0.0010	75-125	75-125	30
p-Isopropyltoluene	0.0005	0.0010	74-125	75-125	30
sec-Butylbenzene	0.0005	0.0010	73-125	75-126	30
tert-Butylbenzene	0.0005	0.0010	73-125	75-125	30
trans-1,2-Dichloroethene	0.0002	0.0010	74-125	75-135	30
trans-1,3-Dichloropropene	0.0020	0.0040	75-125	75-125	30
1,2-Dichloroethane-d4 (surr)			75-125	NA	NA
4-Bromofluorobenzene (surr)			75-125	NA	NA
Dibromofluoromethane (surr)			75-125	NA	NA
Toluene-d8 (surr)			75-125	NA	NA

Table 5
Laboratory Accuracy and Precision Limits - Groundwater
Quality Assurance Project Plan
Site Investigation
BP Site #5482 - Former Standard Oil Bulk Plant
Wedron, LaSalle County, Illinois
Stantec Project No.: 182630000

Target Analyte	Water				
	MDL	RL	LCS limits	MS/MSD	
	mg/L	mg/L	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Method 8270C					
1,2,4-Trichlorobenzene	0.0050	0.0100	62-125	56-125	30
1,2-Dichlorobenzene	0.0014	0.0100	57-125	50-125	30
1,2-Diphenylhydrazine	0.0050	0.0100	65-125	48-126	30
1,3-Dichlorobenzene	0.0013	0.0100	54-125	50-125	30
1,4-Dichlorobenzene	0.0013	0.0100	55-125	51-125	30
1-Methylnaphthalene	0.0050	0.0100	69-125	62-125	30
2,4,5-Trichlorophenol	0.0050	0.0100	66-125	68-125	30
2,4,6-Trichlorophenol	0.0050	0.0100	65-125	69-125	30
2,4-Dichlorophenol	0.0050	0.0100	65-125	65-125	30
2,4-Dimethylphenol	0.0050	0.0100	54-125	44-125	30
2,4-Dinitrotoluene	0.0050	0.0100	70-125	30-150	30
2,4-Dinitrophenol	0.0050	0.0100	30-127	69-125	30
2,6-Dinitrotoluene	0.0050	0.0100	71-125	71-125	30
2-Chloronaphthalene	0.0050	0.0100	67-125	65-125	30
2-Chlorophenol	0.0050	0.0100	58-125	55-125	30
2-Methylnaphthalene	0.0050	0.0100	67-125	64-125	30
2-Methylphenol(o-Cresol)	0.0050	0.0100	60-125	56-125	30
2-Nitroaniline	0.0050	0.0100	65-125	56-125	30
2-Nitrophenol	0.0050	0.0100	61-125	63-125	30
3&4-Methylphenol	0.0100	0.0200	61-125	63-125	30
3,3'-Dichlorobenzidine	0.0050	0.0100	54-128	30-137	30
3-Nitroaniline	0.0050	0.0100	65-125	30-137	30
4,6-Dinitro-2-methylphenol	0.0050	0.0100	30-138	35-139	30
4-Bromophenylphenyl ether	0.0011	0.0100	71-125	69-125	30
4-Chloro-3-methylphenol	0.0050	0.0100	68-125	66-125	30
4-Chloroaniline	0.0050	0.0100	56-125	30-126	30
4-Chlorophenylphenyl ether	0.0050	0.0100	70-125	69-125	30
4-Nitroaniline	0.0050	0.0100	55-125	30-138	30
4-Nitrophenol	0.0050	0.0100	57-125	52-127	30
Acenaphthene	0.0050	0.0100	67-125	69-125	30
Acenaphthylene	0.0050	0.0100	68-125	65-125	30
Anthracene	0.0011	0.0100	71-125	65-125	30
Benzo(a)anthracene	0.0050	0.0100	72-125	65-125	30
Benzo(a)pyrene	0.0011	0.0100	71-125	66-125	30
Benzo(b)fluoranthene	0.0050	0.0100	72-125	68-125	30
Benzo(g,h,i)perylene	0.0010	0.0100	70-125	71-125	30
Benzo(k)fluoranthene	0.0011	0.0100	70-125	66-125	30
bis(2-Chloroethoxy)methane	0.0025	0.0100	63-125	56-125	30
bis(2-Chloroisopropyl)ether	0.0020	0.0100	36-126	33-125	30
bis(2-Ethylhexyl)phthalate	0.0046	0.0100	67-125	68-125	30
bis(2-Chloroethyl) ether	0.0050	0.0100	53-125	41-125	30
Butylbenzylphthalate	0.0050	0.0100	68-125	64-125	30

Table 5
Laboratory Accuracy and Precision Limits - Groundwater
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Site Investigation
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Target Analyte	Water				
	MDL	RL	LCS limits	MS/MSD	
	mg/L	mg/L	% Recovery Limits	% Recovery Limits	RPD Limits (%)
Carbazole	0.0011	0.0100	67-125	67-125	30
Chrysene	0.0050	0.0100	72-125	66-125	30
Dibenz(a,h)anthracene	0.0050	0.0100	70-125	68-125	30
Dibenzofuran	0.0050	0.0100	69-125	68-125	30
Diethylphthalate	0.0050	0.0100	70-125	69-125	30
Dimethylphthalate	0.0050	0.0100	70-125	72-125	30
Di-n-butylphthalate	0.0050	0.0100	71-125	67-125	30
Di-n-octylphthalate	0.0050	0.0100	67-125	66-125	30
Fluoranthene	0.0050	0.0100	72-125	69-125	30
Fluroene	0.0050	0.0100	70-125	70-125	30
Hexachloro-1,3-butadiene	0.0014	0.0100	57-125	50-125	30
Hexachlorobenzene	0.0050	0.0100	70-125	67-125	30
Hexachloroethane	0.0020	0.0100	45-125	37-125	30
Indeno(1,2,3-cd)pyrene	0.0050	0.0100	71-125	68-125	30
Isophorone	0.0050	0.0100	68-125	63-125	30
Naphthalene	0.0050	0.0100	65-125	54-125	30
Nitrobenzene	0.0013	0.0100	63-125	52-125	30
N-Nitrosodimethylamine	0.0012	0.0100	41-125	40-125	30
N-Nitroso-di-n-propylamine	0.0011	0.0100	62-125	50-125	30
N-Nitrosodiphenylamine	0.0050	0.0100	69-125	60-125	30
Pentachlorophenol	0.0050	0.0200	50-125	30-148	30
Phenanthrene	0.0011	0.0100	72-125	70-125	30
Phenol	0.0050	0.0100	56-125	45-125	30
Pyrene	0.0050	0.0100	69-125	69-125	30
2,4,6-Tribromophenol (surr)			55-125	NA	NA
2-Fluorobiphenyl (surr)			60-125	NA	NA
2-Fluorophenol (surr)			53-125	NA	NA
Nitrobenzene-d5 (surr)			60-125	NA	NA
Phenol-d6 (surr)			56-125	NA	NA
Terphenyl-d14 (surr)			56-125	NA	NA
Method 6010B					
Lead	1.24	10	80-120	75-125	20
Method 8015B					
GRO	0.05	0.1	80-120	80-120	20
a,a,a-Trifluorotoluene (surr)			75-125	NA	NA
Method 8015B					
DRO (C10 - C28)	0.011	0.05	61-125	61-125	30
DRO (C24 - C36)	0.02	0.1	61-125	61-125	30
n-Pentacosane (surr)			57-125	NA	NA

NA: not applicable
surr: surrogate

Appendix A

Stantec

APPENDIX A
LABORATORY QUALITY ASSURANCE MANUAL

Quality Assurance Project Plan
Site Investigation
BP Products North America, Inc. Site # 5482

QUALITY ASSURANCE MANUAL

Quality Assurance/Quality Control Policies and Procedures

Pace Analytical Services – Minneapolis
1700 Elm Street SE, Suite 200, Minneapolis, MN 55414
612-607-1700

Pace Analytical Services, Inc. – Montana
602 South 25th Street, Billings, Montana 59101
406-254-7226

CORPORATE APPROVAL

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President/CEO
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5-20-2013
Date

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5-20-2013
Date

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LOCAL APPROVAL

Laboratory Senior General Manager
612-607-6352
Date: 23May2013

Laboratory Senior Quality Manager
612-607-6352
Date: 23May2013

Laboratory Technical Director
612-607-6390
Date: 5/22/13

Laboratory Operations Manager
612-607-6381
Date: 5-23-13

Laboratory Specialty Manager
612-607-6450
Date: 22 May 2013

Client Services Manager
612-607-6382
Date: 22 May 2013

Laboratory Services Manager
406-552-1792
Date: 20 May 2013

Effective Date is the date of the last signature.

Table of Contents

1.0. INTRODUCTION AND ORGANIZATIONAL STRUCTURE

"Working together to protect our environment and improve our health"
Pace Analytical Services Inc. - Mission Statement

1.1. Introduction to PASI

1.1.1. Pace Analytical Services, Inc. (PASI) is a privately held, full-service analytical testing firm operating a nationwide system of laboratories. PASI offers extensive services beyond standard analytical testing, including: bioassay for aquatic toxicity, air toxics, industrial hygiene testing, explosives, dioxins and coplanar PCB's by high resolution mass spectroscopy , radiochemical analyses, product testing, pharmaceutical testing, field services and mobile laboratory capabilities. PASI has implemented a consistent Quality System in each of its laboratories and service centers. In addition, the company utilizes an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems ensure data reliability and superior on-time performance. This document defines the Quality System and QA/QC protocols.

1.1.2. Our goal is to combine our expertise in laboratory operations with customized solutions to meet the specific needs of our customers.

1.2. Statement of Purpose

1.2.1. To meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

1.3. Quality Policy Statement and Goals of the Quality System

1.3.1. PASI management is committed to maintaining the highest possible standard of service for our customers by following a documented quality system. The overall objective of this quality system is to provide reliable data of known quality through adherence to rigorous quality assurance policies and quality control procedures as documented in this Quality Assurance Manual.

1.3.2. All personnel within the PASI network are required to be familiar with all facets of the quality system relevant to their position and implement these policies and procedures in their daily work. This daily focus on quality is applied with initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

1.3.3. PASI management demonstrates its commitment to quality by providing the resources, including facilities, equipment, and personnel to ensure the adherence to these documented policies and procedures and to promote the continuous improvement of the quality system. All PASI personnel must comply with all current applicable state, federal, and industry standards, and are required to perform all tests in accordance with stated methods and customer requirements.

1.4. Core Values

1.4.1. **Integrity**- Pace personnel are required to abide by the PASI Code of Ethics and all Pace employees must go through Data Integrity/Ethics training upon initial orientation and as an annual refresher.

1.4.2. **Value Employees-** Pace management views employees as our most important asset and communicates to them the relevance and importance of their activities within their job functions and how they contribute to the achievement of the objectives of the quality management system.

1.4.3. **Know Our Customers-** Pace makes every effort to know our customers and address their sampling and analytical needs. More information on this item can be found in section 2.0.

1.4.4. **Honor Commitments-** Pace labs focus on making solid commitments with regards to quality, capacity, and agreed upon turnaround time to our customers.

1.4.5. **Flexible Response To Demand-** Pace labs are equipped with both the material and personnel resources to enable them to be responsive to the demands of customers when situations or projects need change.

1.4.6. **Pursue Opportunities-** Pace is committed to pursuing opportunities for the growth of the company by constantly exploring markets and areas where we can expand.

1.4.7. **Continuously Improve-** Pace has committed much time and effort into establishing a continuous improvement program where company personnel meet on a regular basis to share ideas in cost reduction, production improvement and standardization in order to develop best practices. This information, as well as company financial and production metrics, are tracked, evaluated, and shared with each Pace facility.

1.5. Code of Ethics

1.5.1. PASI's fundamental ethical principles are as follows:

1.5.1.1. Each PASI employee is responsible for the propriety and consequences of his or her actions;

1.5.1.2. Each PASI employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where PASI does business or seeks to do business;

1.5.1.3. Each PASI employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with customers, suppliers, the public, and one another.

1.5.1.4. Each PASI employee must recognize and understand that our daily activities in environmental laboratories affect public health as well as the environment and that environmental laboratory analysts are a critical part of the system society depends upon to improve and guard our natural resources:

1.5.2. Strict adherence by each PASI employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of PASI and to continue the pursuit of our common mission to protect our environment and improve our health.

1.5.3. Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

1.5.4. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

1.6. Standards of Conduct

1.6.1. Data Integrity

1.6.1.1. The accuracy and integrity of the analytical results and its supporting documentation produced at PASI are the cornerstones of the company. Lack of data integrity is an assault on our most basic values putting PASI and its employees at grave financial and legal risk and will not be tolerated. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations, and databases. Employees are prohibited from making false entries or misrepresentations of data for any reason.

1.6.1.2. Managerial staff must make every effort to ensure that personnel are free from any undue pressures that may affect the quality or integrity of their work including commercial, financial, over-scheduling, and working condition pressures.

1.6.2. Confidentiality

1.6.2.1. PASI employees must not use or disclose confidential or proprietary information except when in connection with their duties at PASI. This is effective over the course of employment and for an additional period of two years thereafter.

1.6.2.2. Confidential or proprietary information, belonging to either PASI and/or its customers, includes but is not limited to test results, trade secrets, research and development matters, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and customer information, inventions, materials composition, etc.

1.6.3. Conflict of Interest

1.6.3.1. PASI employees must avoid situations that might involve a conflict of interest or could appear questionable to others. The employee must be careful in two general areas:

1.6.3.1.1. Participation in activities that conflict or appear to conflict with the employees' PASI responsibilities.

1.6.3.1.2. Offering or accepting anything that might influence the recipient or cause another person to believe that the recipient may be influenced to behave or in a different manner than he would normally. This includes bribes, gifts, kickbacks, or illegal payments.

1.6.3.2. Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other problematic activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company, or participation in any outside business during the employee's work hours.

1.6.4. Compliance

1.6.4.1. All employees are required to read, understand, and comply with the various components of the standards listed in this document. As confirmation that they understand their responsibility, each employee is required to sign an acknowledgment form annually that then becomes part of the employee's permanent record. Employees will be held accountable for complying with the Quality Systems as summarized in the Quality Assurance Manual.

1.7. Laboratory Organization

1.7.1. The PASI Corporate Office centralizes company-wide accounting, business development, financial management, human resources development, information systems, marketing, quality, safety, and training activities. PASI's Director of Quality is responsible for assisting the

development, implementation and monitoring of quality programs for the company. See Attachment IIB for the Corporate Organizational structure.

1.7.2. Each laboratory within the system operates with local management, but all labs share common systems and receive support from the Corporate Office.

1.7.3. A Senior General Manager (SGM) oversees all laboratories and service centers in their assigned region. Each laboratory or facility in the company is then directly managed by an SGM, a General Manager (GM), an Assistant General Manager (AGM), or an Operations Manager (OM). Quality Managers (QM) or Senior Quality Managers (SQM) at each laboratory report directly to the highest level of local laboratory management, however named, that routinely makes day-to-day decisions regarding that facility's operations. The QMs and SQMs will also receive guidance and direction from the corporate Director of Quality.

1.7.4. The SGM, GM, AGM or OM, or equivalent functionality in each facility, bears the responsibility for the laboratory operations and serves as the final, local authority in all matters. In the absence of these managers, the SQM/QM serves as the next in command. He or she assumes the responsibilities of the manager, however named, until the manager is available to resume the duties of their position. In the absence of both the manager and the SQM/QM, management responsibility of the laboratory is passed to the Technical Director, provided such a position is identified, and then to the most senior department manager until the return of the lab manager or SQM/QM. The most senior department manager in charge may include the Client Services Manager or the Administrative Business Manager at the discretion of the SGM/GM/AGM/OM.

1.7.5. A Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical director to temporarily perform this function. The laboratory SGM/GM/AGM/OM or SQM/QM has the authority to make this designation in the event the existing Technical Director is unable to do so. If this absence exceeds 35 consecutive calendar days, the primary accrediting authority shall be notified in writing.

1.7.6. The SQM/QM has the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or following the policies set forth in this Quality Assurance Manual, the SQM/QM has the authority to halt laboratory operations should he or she deem such an action necessary. The SQM/QM will immediately communicate the halting of operations to the SGM/GM/AGM/OM and keep them posted on the progress of corrective actions. In the event the SGM/GM/AGM/OM and the SQM/QM are not in agreement as to the need for the suspension, the Chief Operating Officer and Director of Quality will be called in to mediate the situation.

1.7.7. The technical staff of the laboratory is generally organized into the following functional groups:

- Organic Sample Preparation
- Wet Chemistry Analysis
- Metals Analysis
- Volatiles Analysis
- Semi-volatiles Analysis
- Radiochemical Analysis
- Microbiology

1.7.8. Appropriate support groups are present in each laboratory. The actual organizational structure for PASI – Minneapolis and Billings is listed in Attachment IIA. In the event of a change in SGM/GM/AGM/OM, SQM/QM, or any Technical Director, the laboratory will notify its accrediting

authorities and revise the organizational chart in the Quality Assurance Manual (QAM) within 30 days. For changes in Department Managers or Supervisors or other laboratory personnel, no notifications will be sent to the laboratory's accrediting agencies; changes to the organizational chart will be updated during or prior to the annual review process. Changes or additions in these key personnel will also be noted by additional signatures on the QAM, as applicable. In any case, the QAM will remain in effect until the next scheduled revision.

1.8. Laboratory Job Descriptions

1.8.1. Senior General Manager

- Oversees all functions of all the operations within their designated region;
- Oversees the development of local GMs/AGMs/OMs within their designated region;
- Oversees and authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Oversees the preparation of budgets and staffing plans for all operations within their designated region;
- Ensures compliance with all applicable state, federal and industry standards;
- Works closely with Regional Sales Management.

1.8.2. General Manager

- Oversees all functions of their assigned operations;
- Authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Prepares budgets and staffing plans;
- Monitors the Quality Systems of the laboratory and advises the SQM/QM accordingly;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.3. Assistant General Manager / Operations Manager

- In the absence of the SGM/GM, performs all duties as listed above for the SGM or GM;
- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately understood and met;
- Works with SGM/GM to prepare appropriate budget and staffing plans for all departments;
- Responsible for prioritizing personnel and production activities within all departments;
- Performs formal and informal performance reviews of departmental staff.

1.8.4. Senior Quality Manager

- Provides quality oversight for multiple laboratories where there is not a local quality manager or for labs where there are multiple and separately distinct quality systems in the same facility;
- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions

regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality;

- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.5. Quality Manager

- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality. They may also report to a Senior Quality Manager within the same facility;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;

- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.6. Quality Analyst

- Assists the SQM/QM in the performance of quality department responsibilities as delegated by the SQM/QM;
- Assists in monitoring QA/QC data;
- Assists in internal audits;
- Assists in maintaining training records;
- Assists in maintaining the document control system;

1.8.7. Technical Director

- Monitors the standards of performance in quality assurance and quality control data;
- Monitors the validity of analyses performed and data generated;
- Reviews tenders, contracts and QAPPs to ensure the laboratory can meet the data quality objectives for any given project;
- Serves as the manager of the laboratory in the absence of the SGM/GM/AGM/OM and SQM/QM;
- Provides technical guidance in the review, development, and validation of new methodologies.

1.8.8. Administrative Business Manager

- Responsible for financial and administrative management for the entire facility;
- Provides input relative to tactical and strategic planning activities;
- Organizes financial information so that the facility is run as a fiscally responsible business;
- Works with staff to confirm that appropriate processes are put in place to track revenues and expenses;
- Provide ongoing financial information to the SGM/GM/AGM/OM and the management team so they can better manage their business;
- Utilizes historical information and trends to accurately forecast future financial positions;
- Works with management to ensure that key measurements are put in place to be utilized for trend analysis—this will include personnel and supply expenses, and key revenue and expense ratios;
- Works with SGM/GM/AGM/OM to develop accurate budget and track on an ongoing basis;
- Works with entire management team to submit complete and justified capital budget requests and to balance requests across departments;
- Works with project management team and administrative support staff to ensure timely and accurate invoicing.

1.8.9. Client Services Manager

- Oversees all the day to day activities of the Client Services Department which includes Project Management and, possibly, Sample Control;

- Responsible for staffing and all personnel management related issues for Client Services;
- Serves as the primary senior consultant to customers on all project related issues such as set up, initiation, execution and closure;
- Performs or is capable of performing all duties listed for that of Project Manager.

1.8.10. Project Manager

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers and PASI;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate PASI staff to develop project statements of work or resolve problems of data quality;
- Responsible for solicitation of work requests, assisting with proposal preparation and project initiation with customers and maintain customer records;
- Mediation of project schedules and scope of work through communication with internal resources and management;
- Responsible for preparing routine and non-routine quotations, reports and technical papers;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Manages large-scale complex projects;
- Supervises less experienced project managers and provide guidance on management of complex projects;
- Arranges bottle orders and shipment of sample kits to customers;
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

1.8.11. Project Coordinator

- Responsible for preparation of project specifications and provides technical/project support;
- Coordinates project needs with other department sections and assists with proposal preparation;
- Prepares routine proposals and invoicing;
- Responsible for scanning, copying, assembling and binding final reports;
- Other duties include filing, maintaining forms, process outgoing mail, maintaining training database and data entry.

1.8.12. Department Manager/Supervisor

- Oversees the day-to-day production and quality activities of their assigned department;
- Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied;
- Assesses data quality and takes corrective action when necessary;
- Approves and releases technical and data management reports;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.13. Group Supervisor/Leader

- Trains analysts in laboratory operations and analytical procedures;

- Organizes and schedules analyses with consideration for sample holding times;
- Implements data verification procedures by assigning data verification duties to appropriate personnel;
- Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- Reports non-compliance situations to laboratory management including the SQM/QM.

1.8.14. Laboratory Analyst

- Performs detailed preparation and analysis of samples according to published methods and laboratory procedures;
- Processes and evaluates raw data obtained from preparation and analysis steps;
- Generates final results from raw data, performing primary review against method criteria;
- Monitors quality control data associated with analysis and preparation. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks;
- Reports data in LIMS, authorizing for release pending secondary approval;
- Conducts routine and non-routine maintenance of equipment as required;
- Performs or is capable of performing all duties associated with that of Laboratory Technician.

1.8.15. Laboratory Technician

- Prepares standards and reagents according to published methods or in house procedures;
- Performs preparation and analytical steps for basic laboratory methods;
- Works under the direction of a Laboratory Analyst on complex methodologies;
- Assists Laboratory Analysts on preparation, analytical or data reduction steps for complex methodologies;
- Monitors quality control data as required or directed. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

1.8.16. Sample Management Personnel

- Signs for incoming samples and verifies the data entered on the Chain of custody forms;
- Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting;
- Stages samples according to EPA requirements;
- Assists Project Managers and Coordinators in filling bottle orders and sample shipments.

1.8.17. Systems Administrator or Systems Manager

- Assists with the creation and maintenance of electronic data deliverables (EDDs);
- Coordinates the installation and use of all hardware, software and operating systems;
- Performs troubleshooting on all aforementioned systems;
- Trains new and existing users on systems and system upgrades;
- Maintains all system security passwords;
- Maintains the electronic backups of all computer systems.

1.8.18. Safety/Chemical Hygiene Officer

- Maintains the laboratory Chemical Hygiene Plan;
- Plans and implements safety policies and procedures;
- Maintains safety records;
- Organizes and/or performs safety training;
- Performs safety inspections and provides corrective/preventative actions;
- Assists personnel with safety issues.

1.8.19. Program Director/Hazardous Waste Coordinator (or otherwise named)

- Evaluates waste streams and helps to select appropriate waste transportation and disposal companies;
- Maintains complete records of waste disposal including waste manifests and state reports;
- Assists in training personnel on waste-related issues such as waste handling and storage, waste container labeling, proper satellite accumulation, secondary containment, etc.;
- Conducts a weekly inspection of the waste storage areas of the laboratory.

1.9. Training and Orientation

1.9.1. Training for Pace employees is managed through a web-based Learning Management System. After a new employee has been instructed in matters of human resources, they are given instructional materials for the LMS and a password for access.

1.9.2. A new hire training checklist is provided to the new employee that lists training items for the employee to work through either independently on LMS or with their supervisor or trainer. The training items that can be completed independently include:

- Reading through applicable Standard Operating Procedures;
- Reviewing the Quality Manual and Chemical Hygiene Plan;
- Core training modules such as quality control indicators, basic laboratory skills, etc.;
- Quality Systems training including traceability of measurements, method calibration, calibration verification, accuracy, precision and uncertainty of measurements, corrective actions, documentation, and root cause analysis;
- Data Integrity/Ethics training.

1.9.3. The new employee's Department Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of PASI and the basic elements of that individual's position. Supervised training uses the following techniques:

- Hands-on training
- Training checklists/worksheets
- Lectures and training sessions
- Method-specific training
- Conferences and seminars
- Short courses
- Specialized training by instrument manufacturers
- Proficiency testing programs.
- On-line courses

1.9.4. Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee's training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing capability, which are fully detailed in Section 3.4. Training documentation files for each person are maintained by the Quality Office either in hardcopy format or within the LMS.

1.9.5. All procedures and training records are maintained and available for review during laboratory audits. These procedures are reviewed/updated periodically by laboratory management. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

1.10. Data Integrity System

1.10.1. The data integrity system at PASI provides assurances to management that a highly ethical approach is being applied to all planning, training and implementation of methods. Data integrity is crucial to the success of our company and Pace Analytical is committed to creating and maintaining a culture of quality throughout the organization. To accomplish this goal, PASI has implemented a data integrity system that encompasses the following four requirements:

1.10.1.1. A data integrity training program: standardized training is given to each new employee and a yearly refresher is presented to all employees. Key topics addressed by this training include:

1.10.1.1.1. Need for honesty and transparency in analytical reporting
1.10.1.1.2. Process for reporting data integrity issues
1.10.1.1.3. Specific examples of unethical behavior and improper practices
1.10.1.1.4. Documentation of non-conforming data that is still useful to the data user
1.10.1.1.5. Consequences and punishments for unethical behavior
1.10.1.1.6. Examples of monitoring devices used by management to review data and systems

1.10.1.2. Signed data integrity documentation for all employees: this includes a written quiz following the Ethics training session and written agreement to abide by the Code of Ethics and Standards of Conduct explained in the employee manual.

1.10.1.3. In-depth, periodic monitoring of data integrity including peer data review and validation, internal raw data audits, proficiency testing studies, etc.

1.10.1.4. Documentation of any review or investigation into possible data integrity infractions. This documentation, including any disciplinary actions involved, corrective actions taken, and notifications to customers must be retained for a minimum of five years.

1.10.2. PASI management makes every effort to ensure that personnel are free from any undue pressures that affect the quality of their work including commercial, financial, over scheduling, and working condition pressures.

1.10.3. Corporate management also provides all PASI facilities a mechanism for confidential reporting of data integrity issues that ensures confidentiality and a receptive environment in which all employees are comfortable discussing items of ethical concern. The anonymous message line is monitored by the Corporate Director of Quality who will ensure that all concerns are evaluated and, where necessary, brought to the attention of executive management and investigated. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

1.11. Laboratory Safety

1.11.1. It is the policy of PASI to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, personal protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety as well as those working in the immediate area by complying with established company rules and procedures. These rules and procedures as well as a more detailed description of the employees' responsibilities are contained in the corporate Safety Manual and Chemical Hygiene Plan.

1.12. Security and Confidentiality

1.12.1. Security is maintained by controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by PASI staff. Keyless door lock combinations and computer access codes/logins are changed periodically. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors, including PASI staff from other facilities, must sign the Visitor's Logbook maintained by the receptionist. A staff member will accompany them during the duration of their stay on the premises unless the SGM/GM/AGM/OM, SQM/QM, or Technical Director specify otherwise. In this instance, the staff member will escort the visitor back to the reception area at the end of his/her visit where he/she signs out. The last staff member to leave their department for the day must ensure that all outside access points to that area are secure.

1.12.2. Additional security is provided where necessary, (e.g., specific secure areas for sample, data, and customer report storage), as requested by customers, or cases where national security is of concern. These areas are lockable within the facilities, or are securely offsite. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of customer report archives is the responsibility of the Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

1.12.3. Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper authorization. If requested by customer or contract, samples are not to be removed from secure storage areas without filling out an associated internal chain of custody.

1.12.4. Standard business practices of confidentiality are applied to all documents and information regarding customer analyses. Specific protocols for handling confidential documents are described in PASI SOPs. Additional protocols for sample identification by internal laboratory identification numbers only are implemented as required under contract specific Quality Assurance Project Plans (QAPPs).

1.12.5. All information pertaining to a particular customer, including national security concerns will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the company to do so.

1.13. Communications

1.13.1. Management within each lab bears the responsibility of ensuring that appropriate communication processes are established and that communication takes place regarding the effectiveness of the management/quality system. These communication processes may include email, regular staff meetings, senior management meetings, etc.

1.13.2. Corporate management bears the responsibility of ensuring that appropriate communication processes are established within the network of facilities and that communication takes place at a company-wide level regarding the effectiveness of the management/quality systems of all Pace facilities. These communication processes may include email, quarterly continuous improvement conference calls for all lab departments, and annual continuous improvement meetings for all department supervisors, quality managers, client services managers, and other support positions.

2.0. SAMPLE CUSTODY

2.1. Sampling Support

2.1.1. Each individual PASI laboratory provides shipping containers, properly preserved sample containers, custody documents, and field quality control samples to support field-sampling events. Guidelines for sample container types, preservatives, and holding times for a variety of methods are listed in Attachment VIII. Note that all analyses listed are not necessarily performed at all PASI laboratories and there may be additional laboratory analyses performed that are not included in these tables. Customers are encouraged to contact their local Pace Project Manager for questions or clarifications regarding sample handling. PASI – Minneapolis and Billings may provide pick-up and delivery services to their customers when needed.

2.2. Field Services

2.2.1. Pace Analytical has a large Field Services Division which is based in their Minneapolis facility as well as limited field service capabilities in some of our other facilities. Field Services provides comprehensive nationwide service offerings including:

- Stack Testing
- Ambient Air
- CEM Certification Testing
- Air Quality Monitoring
- Onsite Analytical Services- FTIR and GC
- Real-time Process Diagnostic/Optimization Testing
- Wastewater, Groundwater and Drinking Water Monitoring
- Storm Water and Surface Water Monitoring
- Soil and Waste Sampling
- Mobile Laboratory Services

2.2.2. Field Services operates under the PASI Corporate Quality System, with applicable and necessary provisions to address the activities, methods, and goals specific to Field Services. All procedures and methods used by Field Services are documented in Standard Operating Procedures and Procedure Manuals.

2.3. Project Initiation

2.3.1. Prior to accepting new work, the laboratory reviews its performance capability. The laboratory confirms that sufficient personnel, equipment capacity, analytical method capability, etc., are available to complete the required work. Customer needs, certification requirements, and data quality objectives are defined and the appropriate sampling and analysis plan is developed to meet the project requirements by project managers or sales representatives. Members of the management staff review current instrument capacity, personnel availability and training, analytical procedures capability, and projected sample load. Management then informs the sales and client services personnel whether or not the laboratory can accept the new project via written correspondence, email, and/or daily operations meetings.

2.3.2. The laboratory maintains records of all such reviews, including discussions with customers. Routine analytical project documentation of quotes, notes, dates, initials, and/or recordings is maintained in a project folder by project management. Conditions for new and more complex contracts are determined by the SGM/GM/AGM/OM and sales representatives. Quality Management is consulted on technical requirements and operations staff provides input on volume capacities. Evidence of these reviews is maintained in the form of awarded Request for Proposals (RFPs), signed quotes or contracts, and a Customer Relationship Management (CRM) database. If a review identifies a potential mismatch between customer requirements and laboratory capabilities and/or capacities, Pace will specify its level of commitment by listing these exceptions to the requirements within the RFP, quote or contract.

2.3.3. Additional information regarding specific procedures for reviewing new work requests can be found in SOP S-MN-Q-270 **Review of Analytical Requests** or its equivalent revision or replacement.

2.4. Chain of Custody

2.4.1. A chain of custody (COC) provides the legal documentation of samples from time of collection to completion of analysis. PASI has implemented Standard Operating Procedures to ensure that sample custody traceability and responsibility objectives are achieved for every project.

2.4.2. Field personnel or client representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of completeness of COCs is stressed to the samplers and is critical to efficient sample receipt and to insure the requested methods are used to analyze the correct samples.

2.4.3. If sample shipments are not accompanied by the correct documentation, the Sample Receiving department notifies a Project Manager. The Project Manager then obtains the correct documentation/information from the customer in order for analysis of samples to proceed.

2.4.4. The sampler is responsible for providing the following information on the chain of custody form:

- Customer project name
- Project location or number
- Field sample number/identification
- Date and time sampled
- Sample matrix
- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature
- Date and time relinquished
- Sampler remarks as needed
- Custody Seal Number if present
- Regulatory Program Designation
- The state where the samples were collected to ensure all applicable state requirements are met
- Turnaround time requested
- Purchase order number

2.4.5. The COC is filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are recorded on the chain of custody in the "relinquished" and "received by" sections. All information except signatures is printed.

2.4.6. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.5. Sample Acceptance Policy

2.5.1. In accordance with regulatory guidelines, PASI complies with the following sample acceptance policy for all samples received.

2.5.2. If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

2.5.2.1. For Ohio VAP samples, the narrative for any report that includes qualified data must also include a discussion of any bias in the results.

2.5.3. All samples must:

- Have unique customer identification that is clearly marked on durable waterproof labels affixed to the sample containers that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have the sampler's name and signature.
- Have all requested analyses clearly designated on the COC.
- Have clear documentation of any special analytical or data reporting requirements.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.
- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges - not frozen but $\leq 6°C$ (See Note 1), unless program requirements or customer contractual obligations mandate otherwise (see Note 2). The cooler temperature is recorded directly on the COC and the SCUR. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

Note 1: Temperature will be read and recorded based on the precision of the measuring device. For example, temperatures obtained from a thermometer graduated to 0.1°C will be read and recorded to

±0.1°C. Measurements obtained from a thermometer graduate to 0.5°C will be read to ±0.5°C. Measurements read at the specified precision are not to be rounded down to meet the ≤6°C limit

Note 2: Some microbiology methods allow sample receipt temperatures of up to 10°C. Consult the specific method for microbiology samples received above 6°C prior to initiating corrective action for out of temperature preservation conditions.

Note 3: Biological Tissue Samples must be received frozen at ≤0°C.

2.5.4. Upon sample receipt, the following items are also checked and recorded:

- Presence of custody seals or tapes on the shipping containers;
- Sample condition: Intact, broken/leaking, bubbles in VOA samples;
- Sample holding time;
- Sample pH and residual chlorine when required;
- Appropriate containers.

2.5.5. Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

2.5.6. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.6. Sample Log-in

2.6.1. After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System (LIMS). This permanent record documents receipt of all sample containers including:

- Customer name and contact
- Customer number
- Pace Analytical project number
- Pace Analytical Project Manager
- Sample descriptions
- Due dates
- List of analyses requested
- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

2.6.2. All samples received are logged into the LIMS within one working day of receipt. Sample login may be delayed due to customer clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances. If the time collected for any sample is unspecified and Pace is unable to obtain this information from the customer, the laboratory will use 08:00 as the time sampled. All hold times will be based on this sampling time and qualified accordingly if exceeded.

2.6.3. For DoD work, if the time of the sample collection is not provided, the laboratory must assume the most conservative time of day. This is defined as 12:01am.

2.6.4. The Laboratory Information Management System (EPIC Pro) automatically generates a unique identification number for each sample created in the system. The LIMS sample number follows the general convention of BB-XXXXXX-YYY. The BB represents the laboratory identification within Pace's laboratory network. The 5 digit "X" number represents the project number followed by a 3 digit sample number. The project number is a sequential number that is assigned as a new project is created. The sample number corresponds to the number of samples submitted by the client. In addition to the unique sample ID, there is a sample container ID that consists of the sample number, the container type (e.g. BP1U), and bottle 1 of Y, where Y represents the total number of containers of that particular type. Together the sample LIMs number and sample container ID number create a unique barcode encryption that can be linked to the sample analysis requested by the client. This unique identification number is placed on the sample container as a durable label and becomes the link between the laboratory's sample management system and the customer's field identification; it will be a permanent reference number for all future interactions.

2.6.5. Current division codes are noted below. These division codes are used primarily for accounting purposes and LIMS sample identifications. More division codes may be added without updating this document.

10 = Minnesota/Montana	35 = Florida
92 = Asheville and Charlotte	20 = Gulf Coast
60 = Kansas	30 = Pittsburgh
50 = Indianapolis	40 = Green Bay
12 = Virginia/Duluth MN	17 = Pace Life Sciences
51 = Columbus	65 = Schenectady, NY
75 = Dallas	36 = South Florida

2.6.6. Sample labels are printed from the LIMS and affixed to each sample container.

2.6.7. Samples with hold times that are near expiration date/time may be sent directly to the laboratory for analysis at the discretion of the Project Manager and/or SGM/GM/AGM/OM.

2.6.8. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.7. Sample Storage

2.7.1. Storage Conditions

2.7.1.1. Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

2.7.1.2. Storage blanks, consisting of two 40mL aliquots of reagent water, are stored with volatile samples and are used to measure cross-contamination acquired during storage. If applicable, laboratories must have documented procedures and criteria for evaluating storage blanks, appropriate to the types of samples being stored.

2.7.1.3. Additional information can be found in S-MN-Q-263 **Monitoring Storage Units,** or equivalent replacement.

2.7.2. **Temperature Monitoring**

2.7.2.1. Samples are taken to the appropriate storage location immediately after sample receipt and check-in procedures are completed. All sample storage areas are located in limited access areas and are monitored to ensure sample integrity.

2.7.2.2. The temperature of each refrigerated storage area is maintained at ≤6°C unless state or program requirements differ. The temperature of each freezer storage area is maintained at <-10°C unless state or program requirements differ. The temperature of each storage area is checked and documented each day of use (each calendar day). If the temperature falls outside the acceptable limits, the following corrective actions are taken and appropriately documented:

- The temperature is rechecked after two hours to verify temperature exceedance. Corrective action is initiated and documented if necessary.
- The SQM/QM and/or laboratory management are notified if the problem persists.
- The samples are relocated to a proper environment if the temperature cannot be maintained after corrective actions are implemented.
- The affected customers are notified.
- Documentation is provided on analytical report.

Additional information can be found in S-MN-Q-263 **Monitoring Storage Units,** or equivalent replacement.

2.7.3. **Hazardous Materials**

2.7.3.1. Pure product or potentially heavily contaminated samples must be tagged as "hazardous" or "lab pack" and stored separately from other samples.

2.7.4. **Foreign/Quarantined Soils**

2.7.4.1. Depending on the soil disposal practices of the laboratory, foreign soils and soils from USDA regulated areas are adequately segregated to enable proper sample disposal. The USDA requires these samples to be incinerated or sterilized by an approved treatment procedure. Additional information regarding USDA regulations and sample handling can be found in applicable local laboratory SOPs.

2.7.4.2. Additional information on sample storage can be found in S-MN-C-001 **Sample Management** and in S-MN-S-003 **Waste Handling and Management,** or the equivalent revisions or replacements.

2.8. Sample Protection

2.8.1. PASI laboratory facilities are operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times.

2.8.2. Samples are removed from storage areas by designated personnel and returned to the storage areas, if necessary, immediately after the required sample quantity has been taken.

2.8.3. Upon customer request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For example, some projects may require internal chain-of-custody protocols.

2.8.4. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.9. Subcontracting Analytical Services

2.9.1. Every effort is made to perform all analyses for PASI customers within the laboratory that receives the samples. When subcontracting to a laboratory other than the receiving laboratory, whether inside or outside the PASI network, becomes necessary, a preliminary verbal communication with that laboratory is undertaken. Customers are notified in writing of the laboratory's intention to subcontract any portion of the testing to another laboratory. Work performed under specific protocols may involve special considerations.

2.9.2. Prior to subcontracting samples to a laboratory outside Pace Analytical, the potential sub-contract laboratory will be pre-qualified by verifying that the subcontractor meets the following criteria:

- All certifications required for the proposed subcontract are in effect,
- Sufficient professional liability and other required insurance coverage is in effect, and
- Is not involved in legal action by any federal, state, or local government agency for data integrity issues and has not been convicted in such investigation at any time during the past 5 years.

2.9.3. The contact and preliminary arrangements are made between the PASI Project Manager and the appropriate subcontract laboratory personnel. The specific terms of the subcontract laboratory agreement include:

- Method of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn-around time requirements

2.9.4. Chain-of-custody forms are generated for samples requiring subcontracting to other laboratories. Sample receiving personnel re-package the samples for shipment, create a transfer chain of custody form and record the following information:

- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions regarding turnaround, required detection or reporting limits, or any unusual information known about the samples or analytical procedure.
- Signature in "Relinquished By"

2.9.5. All subcontracted sample data reports are sent to the PASI Project Manager. Pace will provide a copy of the subcontractor's report to the client when requested.

2.9.6. Any Pace Analytical work sent to other labs within the PASI network is handled as subcontracted work and all final reports are labeled clearly with the name of the laboratory performing the work. Any non-TNI work is clearly identified. PASI will not be responsible for analytical data if the subcontract laboratory was designated by the customer.

2.9.7. Additional information can be found in S-MN-C-004 **Subcontracting Samples** or its equivalent revision or replacement.

2.9.8. Subcontracted labs used for DoD work must be accredited by DoD or its designated representatives. Subcontracted labs must receive project specific approval from the DoD client before any samples are analyzed. These requirements also apply to the use of any laboratory under the same corporate umbrella, but at a different facility or location.

2.10. Sample Retention and Disposal

2.10.1. Samples, extracts, digestates, and leachates must be retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

2.10.2. Unused portions of samples are retained by each laboratory based on program or customer requirements for sample retention and storage. The minimum sample retention time is 45 days from receipt of the samples. Samples requiring thermal preservation may be stored at ambient temperature when the hold time is expired, the report has been delivered, and/or allowed by the customer, program, or contract. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

2.10.3. After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires PASI to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

2.10.4. Additional information can be found in S-MN-S-003 **Waste Handling and Management** and S-MN-C-001 **Sample Management** or their equivalent revisions or replacements.

3.0. ANALYTICAL CAPABILITIES

3.1. Analytical Method Sources

3.1.1. PASI laboratories are capable of analyzing a full range of environmental samples from a variety of matrices, including air, surface water, wastewater, groundwater, soil, sediment, biota, and other waste products. The latest valid editions of methodologies are applied from regulatory and professional sources including EPA, ASTM, USGS, NIOSH, Standard Methods, and State Agencies. Section 11 is a representative listing of general analytical protocol references. PASI discloses in writing to its customers and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

3.1.2. In the event of a customer-specific need, instrumentation constraint or regulatory requirement, PASI laboratories reserve the right to use valid versions of methods that may not be the most recent edition available.

3.2. Analytical Method Documentation

3.2.1. The primary form of PASI laboratory documentation of analytical methods is the Standard Operating Procedure (SOP). SOPs contain pertinent information as to what steps are required by an analyst to successfully perform a procedure. The required contents for the SOPs are specified in the SOP for Preparation of SOPs S-MN-Q-273, or its equivalent replacement or revision.

3.2.2. The SOPs may be supplemented by other training materials that further detail how methods are specifically performed. This training material will undergo periodic, documented review along with the other Quality System documentation.

3.3. Analytical Method Validation

3.3.1. In some situations, PASI develops and validates methodologies that may be more applicable to a specific problem or objective. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. Method validity is established by meeting criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data. The laboratory records the validation procedure, the results obtained and a statement as to the usability of the method. The minimum requirements for method validation include evaluation of sensitivity, quantitation, precision, bias, and selectivity of each analyte of interest.

3.3.2. Additional information can be found in SOP S-MN-Q-252 **Method Validation and Modification Studies**, or equivalent replacement.

3.4. Demonstration of Capability (DOC)

3.4.1. Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method, or at any time that a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of a quality control standard is calculated and compared to method criteria (if available) or established laboratory criteria for evaluation of acceptance. Each laboratory maintains copies of all demonstrations of capability,

including those that fail acceptance criteria and corresponding raw data for future reference and must document the acceptance criteria prior to the analysis of the DOC. Demonstrations of capability are verified on an annual basis.

3.4.2. For Continuing Demonstrations of Capability, the laboratories may use Performance Testing (PT) samples in lieu of the 4-replicate approach listed above. For methods or procedures that do not lend themselves to the "4-replicate" approach, the demonstration of capability requirements will be specified in the applicable SOP. Drinking Water DOCs must be done at or below the MCL.

3.4.3. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

3.5. Regulatory and Method Compliance

3.5.1. PASI understands that expectations of our customers commonly include the assumption that laboratory data will satisfy specific regulatory requirements. Therefore PASI attempts to ascertain, prior to beginning a project, what applicable regulatory jurisdiction, agency, or protocols apply to that project. This information is also required on the chain of custody submitted with samples.

3.5.2. PASI makes every effort to detect regulatory or project plan inconsistencies, based upon information from the customer, and communicate them immediately to the customer in order to aid in the decision making process. PASI will not be liable if the customer chooses not to follow PASI recommendations.

3.5.3. It is PASI policy to disclose in a forthright manner any detected noncompliance affecting the usability of data produced by our laboratories. The laboratory will notify customers within 30 days of fully characterizing the nature of the nonconformance, the scope of the nonconformance and the impact it may have on data usability.

4.0. QUALITY CONTROL PROCEDURES

Quality control data is analyzed and where they are found to be outside pre-defined criteria, planned action is taken to correct the problem in order to prevent incorrect results from being reported. Quality control samples are to be processed in the same manner as client samples.

4.1. Method Blank

4.1.1. A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples.

4.1.2. A method blank is processed at a minimum frequency of one per preparation batch (see glossary section of this document for further clarification of the definition of batch). In the case of a method that has no separate preparation step, a method blank is processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.1.3. The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature

4.1.4. Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater than 1/10 of the amount of that analyte found in any associated sample. Some labs, due to client requirements, etc., may have to evaluate their method blanks down to ½ the reporting limit as opposed to the reporting limit itself. Corrective actions for blank contamination may include the re-preparation and re-analysis of all samples (where possible) and quality control samples. Data qualifiers must be applied to results that are considered affected by contamination in a method blank.

4.1.5. For DoD samples, the method blank will be considered to be contaminated if: 1) The concentration of any target analyte in the blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater; 2) The concentration of any common laboratory contaminant in the blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater or 3) The blank result otherwise affects the sample results as per the test method requirements or the project-specific objectives. If the method blank is contaminated as described above, then the laboratory shall reprocess affected samples in a subsequent preparation batch, except when sample results are below the LOD. If insufficient sample volume remains for reprocessing, the results shall be reported with appropriate data qualifiers.

4.1.6. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.1.7. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of method blank having any reportable contamination, the laboratory is required to reanalyze the associated samples with an acceptable method blank if there is sufficient sample remaining. Acceptable method blanks are those that are free of contamination below the reporting limit. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding method blanks for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.2. Laboratory Control Sample

4.2.1. The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis.

4.2.2. An LCS is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, an LCS will be processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.2.3. The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes.

4.2.4. The LCS contains **all** analytes specified by a specific method or by the customer or regulatory agency, which may include full list of target compounds, with certain exceptions. These exceptions may include analyzing only specific Aroclors when PCB analysis is requested or not spiking with all EPA Appendix IX compounds when a full Appendix IX list of compounds is requested. However, the lab must ensure that all target components in its scope of accreditation are included in the spike mixture for the LCS over a two (2) year period. In the absence of specified components, the laboratory will spike the LCS with the following compounds:

- For multi-peak analytes (e.g. PCBs, technical chlordane, toxaphene), a representative standard will be processed.
- For methods with long lists of analytes, a representative number of target analytes may be chosen. The following criteria is used to determine the number of LCS compounds used:
  - For methods with 1-10 target compounds, the laboratory will spike with all compounds
  - For methods with 11-20 target compounds, the laboratory will spike with at least 10 compounds or 80%, whichever is greater
  - For methods with greater than 20 compounds, the laboratory will spike with at least 16 compounds.

4.2.5. The LCS is evaluated against the method default or laboratory-derived acceptance criteria. For those methods that require laboratory-derived limits, method default control limits may be used until the laboratory has a minimum of 20, but preferably greater than 30, data points from which to derive internal acceptance criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Any associated sample containing an 'out-of-control' compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. When the acceptance criteria for the LCS are exceeded high, and there are associated samples that are non-detects, then those non-detects can be reported with data qualifiers, or when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit/decision level with data qualifiers.

4.2.6. For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). TNI has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

- >90 analytes in the LCS- 5 analytes
- 71-90 analytes in the LCS- 4 analytes
- 51-70 analytes in the LCS- 3 analytes
- 31-50 analytes in the LCS- 2 analytes
- 11-30 analytes in the LCS- 1 analyte
- <11 analytes in the LCS- no analytes allowed out)

4.2.7. A matrix spike (MS) can be used in place of a non-compliant LCS in a batch as long as the MS passes the LCS acceptance criteria (this is a TNI allowance). When this happens, full documentation must be made available to the data user. If this is not allowed by a customer or regulatory body, the associated samples must be rerun with a compliant LCS (if possible) or reported with appropriate data qualifiers.

4.2.8. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.2.9. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.2.10. For Department of Defense projects, the laboratory is not allowed to have any target analytes that exceed DoD LCS control limits. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Department of Defense projects. All LCS failures must be accounted for in project case narratives. See applicable method SOPs for further corrective action.

4.3. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

4.3.1. A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch unless the MS is actually used as the LCS.

4.3.2. A **Matrix Spike/Matrix Spike Duplicate** (MS/MSD) set is processed at a frequency specified in a particular method or as determined by a specific customer request. This frequency will be specified in the applicable method SOP or customer QAPP. In the absence of such requirements, an MS/MSD set is routinely analyzed once per every 20 samples per matrix per method.

4.3.3. The MS and MSD consist of the sample matrix that is then spiked with known concentrations of target analytes. Laboratory personnel spike customer samples that are specifically designated as MS/MSD samples or, when no designated samples are present in a batch, randomly select samples to spike that have adequate sample volume or weight. Spiked samples are prepared and analyzed in the same manner as the original samples and are selected from different customers if possible.

4.3.4. The MS and MSD contain all analytes specified by a specific method or by the customer or regulatory agency. In the absence of specified components, the laboratory will spike the MS/MSD with the same number of compounds as previously discussed in the LCS section. However, the lab

must ensure that all targeted components in its scope of accreditation are included in the spike mixture for the MS/MSD over a two (2) year period.

4.3.5. The MS and MSD are evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.

4.3.6. A matrix spike and sample duplicate will be performed instead of a matrix spike and matrix spike duplicate when specified by the customer or method.

4.3.7. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.3.8. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of MS/MSD failures, the laboratory is required to reanalyze the associated samples only when the associated LCS also fails acceptance criteria and if there is sufficient sample remaining. When an LCS is acceptable and the MS results are outside of criteria, and no system anomaly is detected, the samples will be reported with appropriate data qualifiers indicating matrix interference. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects.

4.3.9. For DoD work, each preparation batch of samples must contain an associated MS and MSD (or sample duplicate) using the same matrix collected for the specific DoD project. If adequate sample material is not available, then the lack of MS/MSDs shall be noted in the case narrative. Additional MS/MSDs may be required on a project-specific basis. The MS/MSD must be spiked with all target analytes with the exception of PCB analysis, which is spiked per the method. The concentration of the spiked compounds shall be at or below the midpoint of the calibration range or at the appropriate concentration of concern. Multiple spiked samples may need to be prepared to avoid interferences.

4.3.10. For DoD work, the results of all MS/MSD must be evaluated using the same acceptance criteria used for the LCS.

4.4. Sample Duplicate

4.4.1. A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.

4.4.2. The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be 'out of control' and must be qualified appropriately.

4.4.3. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.4.4. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of duplicate samples exceeding the RPD criteria found in applicable analytical SOPs, the laboratory is required to reanalyze the associated sample and duplicate as long as no sampling error was detected if there is sufficient sample remaining. If the sample and duplicate still do not agree, a comment

would be made stating there may be sample non-homogeneity. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding sample duplicates for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.5. Surrogates

4.5.1. Surrogates are compounds that reflect the chemistry of target analytes and are typically added to samples for organic analyses to monitor the effect of the sample matrix on compound recovery.

4.5.2. Surrogates are added to each customer sample (for organics), method blank, LCS, MS, and calibration standard prior to extraction or analysis. The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the client, if applicable. Any surrogate compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Samples with surrogate failures are typically re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error. An exception to this would be samples that have high surrogate values but no reportable hits for target compounds. These samples would be reported, with a qualifier, because the implied high bias would not affect the final results. For methods with multiple surrogates, documentation regarding acceptance and associated compounds will be found in the individual method SOPs.

4.5.2.1. For Ohio VAP samples, the narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.5.2.2. For the TO-15 method surrogates are not evaluated for Ohio VAP samples.

4.5.3. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.6. Internal Standards

4.6.1. Internal Standards are method-specific analytes added to every standard, method blank, laboratory control sample, matrix spike, matrix spike duplicate, sample, and calibration standard at a known concentration, prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. At a minimum, the laboratory will follow method specific guidelines for the treatment of internal standard recoveries as they are related to the reporting of data.

4.6.2. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.6.3. For Ohio VAP projects, samples with internal standard that are outside of method criteria must be reanalyzed to confirm sample matrix effect. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding internal standards for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.7. Field Blanks

4.7.1. Field blanks are blanks prepared at the sampling site in order to monitor for contamination that may be present in the environment where samples are collected. These field quality control

samples are often referenced as field blanks, rinsate blanks, or equipment blanks. The laboratory analyzes these field blanks as normal samples and informs the customer if there are any target compounds detected above the reporting limits.

4.8. Trip Blanks

4.8.1. Trip blanks are blanks that originate from the laboratory as part of the sampling event and are used to monitor for contamination of samples during transport. These blanks accompany the empty sample containers to the field and then accompany the collected samples back to the laboratory. These blanks are routinely analyzed for volatile methods where ambient background contamination is likely to occur.

4.9. Limit of Detection (LOD)

4.9.1. PASI laboratories are required to use a documented procedure to determine a limit of detection for each analyte of concern in each matrix reported. All sample processing steps of the preparation and analytical methods are included in this determination including any clean ups. For any test that does not have a valid LOD, sample results below the limit of quantitation (LOQ) cannot be reported.

4.9.2. The LOD is initially established for the compounds of interest for each method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is then determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. If required by customer, method or accreditation body, the LOD will be re-established annually for all applicable methods.

4.9.3. Unless otherwise noted, the method used by PASI laboratories to determine LODs is based on the Method Detection Limit (MDL) procedure outlined in 40 CFR Part 136, Appendix B. Where required by regulatory program or customer, the above referenced procedure will be followed.

4.9.4. Where specifically stated in the published method, LODs or MDLs will be performed at the listed frequency.

4.9.5. The validity of the LOD must be shown by detection (a value above zero) of the analytes in a QC sample in each quality system matrix. The QC sample must contain the analyte at no more than 3X the LOD for a single analyte test and 4X the LOD for multiple analyte tests. This verification must be performed on each instrument used for sample analysis and reporting of data. The validity of the LOD must be verified as part of the LOD determination process. This verification must be done prior to the use of the LOD for sample analysis.

4.9.6. An LOD study is not required for any analyte for which spiking solutions or quality control samples are not available such as temperature.

4.9.7. The LOD, if required, shall be verified annually for each quality system matrix, technology and analyte. In lieu of performing full LOD (MDL) studies annually, the laboratory can verify the LOD (MDL) on an annual basis, providing this verification is fully documented and does not contradict other customer or program requirements that the laboratory must follow. The requirements of this verification are:

- The spike concentration of the verification must be no more than 3X times the LOD for single analyte tests and 4X the LOD for multiple analyte tests.

- The laboratory must verify the LOD on each instrument used for the reporting of sample data.
- The laboratory must be able to identify all target analytes in the verification standard (distinguishable from noise).

4.9.8. For Ohio VAP projects, a valid MDL must be in place prior to sample analysis. MDLs must be spiked at or below the reporting limit and will not be accepted if it was spike higher than the reporting limit.

4.9.9. DoD definition for LOD- The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.

4.9.10. Additional information can be found in SOP S-MN-Q-269 **Determination of LOD and LOQ** or its equivalent revision or replacement.

4.10. Limit of Quantitation (LOQ)

4.10.1. A limit of quantitation (LOQ) for every analyte of concern must be determined. For PASI laboratories, this LOQ is referred to as the RL, or Reporting Limit. This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g., J flag).

4.10.2. The LOQ must be higher than the LOD.

4.10.3. To verify the LOQ, the laboratory will prepare a sample in the same matrix used for the LCS. The sample will be spiked with each target analyte at a concentration equivalent to the RL or 2X the RL. This sample must undergo the routine sample preparation procedure including any routine sample cleanup steps. The sample is then analyzed and the recovery of each target analyte determined. The recovery for each target analyte must meet the laboratories current control limits for an LCS. The annual LOQ verification is not required if the LOD was determined or verified annually on that instrument.

4.10.4. For DoD approved methods, the LOQ and LOD shall be verified quarterly and valid LOQ must be in place prior to sample analysis.

4.10.5. Additional information can be found in SOP S-MN-Q-269 **Determination of LOD and LOQ** or its equivalent revision or replacement.

4.11. Estimate of Analytical Uncertainty

4.11.1. PASI laboratories can provide an estimation of uncertainty for results generated by the laboratory. The estimate quantifies the error associated with any given result at a 95% confidence interval. This estimate does not include bias that may be associated with sampling. The laboratory has a procedure in place for making this estimation. In the absence of a regulatory or customer-specific procedure, PASI laboratories base this estimation on the recovery data obtained from the Laboratory Control Spikes. The uncertainty is a function of the standard deviation of the recoveries multiplied by the appropriate Student's t Factor at 95% confidence. Additional information pertaining to the estimation of uncertainty and the exact manner in which it is derived are contained

in the SOP S-MN-Q-255 **Estimation of Measurement Uncertainty** or its equivalent revision or replacement.

4.11.2. The measurement of uncertainty is provided only on request by the customer, as required by specification or regulation and when the result is used to determine conformance within a specification limit.

4.12. Proficiency Testing (PT) Studies

4.12.1. PASI laboratories participate in the TNI defined proficiency testing program. PT samples are obtained from NIST approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix.

4.12.2. The laboratory initiates an investigation whenever PT results are deemed 'unacceptable' by the PT provider. All findings and corrective actions taken are reported to the SQM/QM or their designee. A corrective action plan is initiated and this report is sent to the appropriate state accreditation agencies for their review. Additional PTs will be analyzed and reported as needed for certification purposes.

4.12.3. PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

4.12.4. Comparison of analytical results with anyone participating in the same PT study is prohibited prior to the close of the study.

4.12.5. Additional information can be found in SOP S-MN-Q-258 **Proficiency Testing Program** or its equivalent revision or replacement.

4.13. Rounding and Significant Figures

4.13.1. In general, the PASI laboratories report data to no more than three significant digits. Therefore, all measurements made in the analytical process must reflect this level of precision. In the event that a parameter that contributes to the final result has less than three significant figures of precision, the final result must be reported with no more significant figures than that of the parameter in question. The rounding rules listed below are descriptive of the LIMS and not necessarily of any supporting program such as Excel.

4.13.2. Data is compared to the reporting limits and MDLs to determine if qualifiers are needed before the rounding step occurs.

4.13.3. **Rounding:** PASI-Minneapolis and Billings follows the odd / even guidelines for rounding numbers:

- If the figure following the one to be retained is less than five, that figure is dropped and the retained ones are not changed (with three significant figures, 2.544 is rounded to 2.54).
- If the figure following the ones to be retained is greater than five, that figure is dropped and the last retained one is rounded up (with three significant figures, 2.546 is rounded to 2.55).
- If the figure following the ones to be retained is five and if there are no figures other than zeros beyond that five, then the five is dropped and the last figure retained is unchanged if it is

even and rounded up if it is odd (with three significant figures, 2.525 is rounded to 2.52 and 2.535 is rounded to 2.54).

4.13.4. Significant Digits

4.13.4.1. PASI-Minneapolis and Billings follows the following convention for reporting to a specified number of significant figures. Unless specified by federal, state, or local requirements or on specific request by a customer, the laboratory reports:

Values > 10 – Reported to 3 significant digits
Values ≤ 10 – Reported to 2 significant digits

4.14. Retention Time Windows

4.14.1. When chromatographic conditions are changed, retention times and analytical separations are often affected. As a result, two critical aspects of any chromatographic method are the determination and verification of retention times and analyte separation. Retention time windows must be established for the identification of target analytes. The retention times of all target analytes in all calibration verification standards must fall within the retention time windows. If an analyte falls outside the retention time window in an ICV or CCV, new absolute retention time windows must be calculated, unless instrument maintenance fixes the problem. When a new column is installed, a new retention time window study must be performed.

4.14.2. One process for the production of retention time windows: Make 3 injections of all single component or multi-component analytes over a 72-hour period. Record the retention time in minutes for each analyte and surrogate to 3 decimal places. Calculate the mean and standard deviation of the three absolute retention times for each target analyte and surrogate. For multi-component analytes, choose 3-5 major peaks and calculate the mean and standard deviation for each of the peaks. If the standard deviation of the retention times of a target analyte is 0.000, the lab may use a default standard deviation of 0.01. The width of the retention time window for each analyte and surrogate and major peak in a multi-component analyte is defined as +/- 3 times the standard deviation of the mean absolute retention time established during that 72-hour period or 0.03 minutes, whichever is greater.

4.14.3. The center of the retention time window is established for each analyte and surrogate by using the absolute retention times from the CCV at the beginning of the analytical shift. For samples run with an initial calibration, use the retention time of the mid-point standard of the initial calibration curve.

4.14.4. For more information, please reference the local facility's analytical SOPs.

5.0. DOCUMENT MANAGEMENT AND CHANGE CONTROL

5.1. Document Management

5.1.1. Additional information can be found in SOP S-MN-Q-258 **Document Control and Management** or its equivalent revision or replacement. Information on Pace's policy for electronic signatures can also be found in this SOP.

5.1.2. Pace Analytical Services, Inc. has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), Quality Assurance Manuals, quality policy statements, training documents, work-processing documents, charts, posters, memoranda, notices, forms, software, and any other procedures, tables, plans, etc. that have a direct bearing on the quality system (including applicable data records and non-technical documents).

5.1.3. A master list of all managed documents is maintained at each facility identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use in the facility. All documents are reviewed periodically and revised if necessary. Obsolete documents are systematically discarded or archived for audit or knowledge preservation purposes. Copies of all quality systems documentation provided to DoD for review must be in English.

5.1.4. Each managed document is uniquely identified to include the date of issue, the revision identification, page numbers, the total number of pages and the issuing authorities. For complete information on document numbering, refer to SOP S-ALL-Q-003 **Document Numbering**.

5.1.5. SOPs, specifically, are available to all laboratory staff via the Learning Management System (LMS) which is a secure repository that is accessed through an internet portal. As a local alternative to the hard copy system of controlled documents, secured electronic copies of controlled documents may be maintained on the laboratory's local server. These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system are as follows:

- Electronic documents must be readily accessible to all facility employees.
- Electronic documents must be locked from printing. All hardcopy SOPs must be obtained from the Quality Department.

5.1.6. **Quality Assurance Manual (QAM):** The Quality Assurance Manual is the company-wide document that describes all aspects of the quality system for PASI. The base QAM template is distributed by the Corporate Quality Department to each of the SQMs/QMs. The local management personnel modify the necessary and permissible sections of the base template and submit those modifications to the Corporate Director of Quality for review. Once approved and signed by both the CEO and the Director of Quality; the SGM/GM/AGM/OM, the SQM/QM, and any Technical Directors sign the Quality Assurance Manual. Each SQM/QM is then in charge of distribution to employees, external customers or regulatory agencies and maintaining a distribution list of controlled document copies. The Quality Assurance Manual template is reviewed on an annual basis by all of the PASI SQMs/QMs and revised accordingly by the Director of Quality.

5.1.7. Standard Operating Procedures (SOPs)

5.1.7.1. SOPs fall into two categories: company-wide documents and facility specific documents. Company-wide SOPs start with the prefix S-ALL- and local SOPs start with the individual facility prefix.

5.1.7.2. The purpose of the company-wide SOPs is to establish policies and procedure that are common and applicable to all PASI facilities. Company-wide SOPs are document-controlled by the corporate quality office and signed copies are distributed to all of the SQMs/QMs. The local management personnel sign the company-wide SOPs. The SQM/QM is then in charge of distribution to employees, external customers, or regulatory agencies and maintaining a distribution list of controlled document copies.

5.1.7.3. Local PASI facilities are responsible for developing facility-specific SOPs applicable to their respective facility. The local facility develops these facility-specific SOPs based on the corporate-wide SOP template. This template is written to incorporate a set of minimum method requirements and PASI best practice requirements. The local facilities may add to or modify the corporate-wide SOP template provided there are no contradictions to the minimum method or best practice requirements. Facility-specific SOPs are controlled by the applicable SQM/QM according to the corporate document management policies.

5.1.7.4. SOPs are reviewed every two years at a minimum although a more frequent review may be required by some state or federal agencies or customers. If no revisions are made based on this review, documentation of the review itself is made by the addition of new signatures on the cover page. If revisions are made, documentation of the revisions is made in the revisions section of each SOP and a new revision number is applied to the SOP. This provides a historical record of all revisions.

5.1.7.5. All copies of superseded SOPs are removed from general use and the original copy of each SOP is archived for audit or knowledge preservation purposes. This ensures that all PASI employees use the most current version of each SOP and provides the SQM/QM with a historical record of each SOP.

5.1.7.6. Additional information can be found in SOP S-MN-Q-273 **Preparation of SOPs** or its equivalent revision or replacement.

5.1.7.7. For Ohio VAP certification, it is required by the Ohio Administrative Code that the laboratory must seek Ohio VAP review and approval of all SOPs and Quality Manual subsequent modifications prior to implementation.

5.1.7.8. For DoD approval, all technical SOPs are reviewed for accuracy and adequacy annually and whenever method procedures change and updated as appropriate. All such reviews are documented and made available for assessment. Non-technical SOPs that are not required elements of the quality system are considered administrative SOPs and are not required to be reviewed annually

5.1.8. Other Documentation

5.1.8.1. Additional documents such as Forms and Spreadsheets are controlled through the document management system.

5.2. Document Change Control

5.2.1. Changes to managed documents are reviewed and approved in the same manner as the original review. Any revision to a document requires the approval of the applicable signatories. After revisions are approved, a revision number is assigned and the previous version of the document is officially retired. Copies may be kept for audit or knowledge preservation purposes.

5.2.2. All controlled copies of the previous document are replaced with controlled copies of the revised document and the superseded copies are destroyed or archived. All affected personnel are advised that there has been a revision and any necessary training is scheduled.

5.3. Management of Change

5.3.1. The process for documenting necessary changes within the laboratory network are not typically handled using the corrective or preventive action system as outlined in section 9.0. Management of Change is a proactive approach to dealing with change to minimize the potential negative impact of systematic change in the laboratory and to ensure that each change has a positive desired outcome. This process will primarily be used for the implementation of large scale projects and information system changes as a means to apply consistent systems or procedures within the laboratory network. The request for change is submitted by the initiator and subsequently assigned to an individual or team for development and planning. The final completion of the process culminates in final approval and verification that the procedure was effectively implemented. Additional information can be found in SOP S-MN-Q-257 **Management of Change** or its equivalent revision or replacement.

6.0. EQUIPMENT AND MEASUREMENT TRACEABILITY

Each PASI facility is equipped with sufficient instrumentation and support equipment to perform the relevant analytical testing or field procedures performed by each facility. Support equipment includes chemical standards, thermometers, balances, disposable and mechanical pipettes, etc. This section details some of the procedures necessary to maintain traceability and to perform proper calibration of instrumentation and support equipment. See Attachment III for a list of equipment currently used at the (Minneapolis and Billings) PASI facility.

6.1. Standards and Traceability

6.1.1. Each PASI facility retains all pertinent information for standards, reagents, and chemicals to assure traceability to a national standard. This includes documentation of purchase, receipt, preparation, and use.

6.1.2. Upon receipt, all purchased standard reference materials are recorded into a standard logbook or database and assigned a unique identification number. The entries include the facility's unique identification number, the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. Vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

6.1.3. Subsequent preparations of intermediate or working solutions are also documented in a standard logbook or database. These entries include the stock standard name and lot number, the manufacturer name, the solvents used for preparation, the solvent lot number and manufacturer, the preparation steps, preparation date, expiration dates, preparer's initials, and a unique PASI identification number. This number is used in any applicable sample preparation or analysis logbook so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.

6.1.4. All prepared standard or reagent containers include the PASI identification number, the standard or chemical name, the date of preparation, the date of expiration, the concentration with units, and the preparer's initials. This ensures traceability back to the standard preparation logbook.

6.1.5. For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be PASI standard ID, concentration, and expiration date. This assures that no standard will be used past its assigned expiration date.

6.1.6. If a second source standard is required to verify an existing calibration or spiking standard, this standard must be obtained from a different manufacturer or from a different lot unless client specific QAPP requirements state otherwise.

6.1.7. Additional information concerning standards and reagent traceability can be found in the SOP S-MN-Q-275 **Standard and Reagent Management and Traceability** or its equivalent revision or replacement.

6.2. General Analytical Instrument Calibration Procedures (Organic and Inorganic)

6.2.1. All support equipment and instrumentation are calibrated or checked before use to ensure proper functioning and verify that the laboratory's requirements are met. All calibrations are performed by, or under the supervision of, an experienced analyst at scheduled intervals against either certified standards

traceable to recognized national standards or reference standards whose values have been statistically validated.

6.2.2. Calibration standards for each parameter are chosen to establish the linear range of the instrument and must bracket the concentrations of those parameters measured in the samples. The lowest calibration standard is the lowest concentration for which quantitative data may be reported. Data reported below this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in a narrative. The highest calibration standard is the highest concentration for which quantitative data may be reported. Data reported above this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in the narrative. Any specific method requirement for number and type of calibration standards supersedes the general requirement. Instrument and method specific calibration criteria are explained within the specific analytical standard operating procedures for each facility.

6.2.3. Results from all calibration standards analyzed must be included in constructing the calibration curve with the following exceptions:

6.2.3.1. The lowest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The reporting limit must be adjusted to the lowest concentration included in the calibration curve;

6.2.3.2. The highest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done an individual analyte basis. The upper limit of quantitation must be adjusted to the highest concentration included in the calibration curve;

6.2.3.3. Multiple points from either the high end or the low end of the calibration curve may be excluded as long as the remaining points are contiguous in nature and the minimum number of levels remains as established by method or standard operating procedure. The reporting limit or quantitation range, whichever is appropriate, must be adjusted accordingly;

6.2.3.4. Results from a concentration level between the lowest and highest calibration levels can only be excluded from an initial calibration curve for a documentable and acceptable cause with approval from the responsible department supervisor and the local SQM/QM or their designee. An acceptable cause is defined as an obvious sample introduction issue that resulted in no response or a documented response that is less than the lowest standard used in the ICAL. A suspected incorrectly prepared standard is not considered to be an acceptable cause. The results for all analytes are to be excluded and the point must be replaced by re-analysis. Re-analysis of this interior standard must occur within the same 12-hour tune time period for GC/MS methodologies and within 8 hours of the initial analysis of that standard for non-GC/MS methodologies. All samples analyzed prior to the re-analyzed calibration curve point must be re-analyzed after the calibration curve is completed and re-processed against the final calibration curve.

6.2.4. Instrumentation or support equipment that cannot be calibrated to specification or is otherwise defective is clearly labeled as out-of-service until it has been repaired and tested to demonstrate it meets the laboratory's specifications. All repair and maintenance activities including service calls are documented in the maintenance log. Equipment sent off-site for calibration testing is packed and transported to prevent breakage and is in accordance with the calibration laboratory's recommendations.

6.2.5. In the event that recalibration of a piece of test equipment indicates the equipment may have been malfunctioning during the course of sample analysis, an investigation is performed. The results of the investigation along with a summary of the information reviewed are documented and maintained by the quality manager. If the investigation indicates sample results have been impacted, the customer is notified within 30 days. This allows for sufficient investigation and review of documentation to determine the impact on the analytical results. Instrumentation found to be consistently out of calibration is either repaired and positively verified or taken out of service and replaced.

6.2.6. Raw data records are retained to document equipment performance. Sufficient raw data is retained to reconstruct the instrument calibration and explicitly connect the continuing calibration verification to the initial calibration.

6.2.7. **General Organic Calibration Procedures**

6.2.7.1. Calibration standards are prepared at a minimum of five concentrations for organic analyses (unless otherwise stipulated in the method).

6.2.7.2. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Curves that do not meet the appropriate criteria require corrective action that may include re-running the initial calibration curve. Rounding to meet initial calibration criteria is not allowed, that is, 15.3 cannot be rounded down to meet a $\leq$ 15% RSD requirement. This also applies to linear and non-linear fit requirements. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if that lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.7.3. The calibration curve is periodically verified by the analysis of a mid-level continuing calibration verification (CCV) standard during the course of sample analysis. This standard is from the same source as the initial calibration unless otherwise specified in the source method to be from an alternate source material. Rounding to meet continuing calibration criteria is not allowed. Continuing calibration verification is performed at the beginning and end of each analytical batch except if an internal standard is used, then only one verification at the beginning of the batch is needed, whenever it is expected that the analytical system may be out of calibration, if the time period for calibration has expired, or for analytical systems that have specific calibration verification requirements. This verification standard must meet acceptance criteria in order for sample analysis to proceed.

6.2.7.4. In the event that the CCV does not meet the acceptance criteria, a second CCV may be injected as part of the diagnostic evaluation and corrective action investigation. If the second CCV is acceptable, the analytical sequence may be continued. If both CCVs fail, the analytical sequence is terminated and corrective action is initiated. Sample analysis cannot begin until after documented corrective action has been completed and either two consecutive passing CCVs have been analyzed or the instrument has successfully passed a new initial calibration. All samples analyzed since the last compliant CCV are re-analyzed for methodologies utilizing external calibration.

6.2.7.4.1. For DoD labs: the lab must re-analyze CCVs and all samples analyzed since the last successful calibration verification. If re-analysis is not possible, the lab must notify the client prior to reporting data associated with a non-compliant CCV. If these data are reported, the data must be qualified and explained in the case narrative. If the lab routinely analyzes two CCVs, then both CCVs must be evaluated. If either CCV fails, the lab must perform all required corrective actions and re-analyze all samples since the last acceptable calibration verification.

6.2.7.5. When instruments are operating unattended, autosamplers may be programmed to inject consecutive CCVs as a preventative measure against CCV failure with no corrective action. In this case, both CCVs must be evaluated to determine potential impact to the results. A summary of the decision tree and necessary documentation are listed below:

- If both CCVs meet the acceptance criteria, the analytical sequence is allowed to continue without corrective action. The 12 hour clock begins with the injection of the second CCV.
- If the first CCV does not meet the acceptance criteria and the second CCV is acceptable, the analytical sequence is continued and the results are reported.
- If the first CCV meets the acceptance criteria and the second CCV is out of control, the samples after the out of control CCV must be re-analyzed in a compliant analytical sequence.
- If both CCVs are out of control, all samples since the last acceptable CCV must be re-analyzed in a compliant analytical sequence.

6.2.7.6. Some analytical methods require that samples be bracketed by passing CCVs analyzed both before and after the samples. This is specific to each method but, as a general rule, all external calibration methods require bracketing CCVs. Most internal standard calibrations do not require bracketing CCVs.

6.2.7.7. Some analytical methods require verification based on a time interval; some methods require a frequency based on an injection interval. The type and frequency of the calibration verifications is dependent on both the analytical method and possibly on the quality program associated with the samples. The type and frequency of calibration verification will be documented in the method specific SOP employed by each laboratory.

6.2.7.8. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of calibration verification standard failures, the laboratory is required to reanalyze the CCV and the associated samples so as not to report qualified data. Sample results maybe reported if the CCV failure produces a high bias and the samples are non-detect. Where possible, the second attempt should be made using the original aliquot of the standard unless there is reason to suspect that the standard is the cause of failure. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding calibration verification standard failures for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

6.2.8. General Inorganic Calibration Procedures

6.2.8.1. The instrument is initially calibrated with standards at multiple concentrations to establish the linearity of the instrument's response. A calibration blank is also included. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Rounding to meet initial calibration criteria is not allowed. This also applies to linear and non-linear fit requirements. The number of calibration standards used depends on the specific method criteria or customer project requirements, although normally a minimum of three standards is used.

6.2.8.2. The ICP and ICP/MS can be standardized with a zero point and a single point calibration if:

- Prior to analysis, the zero point and the single point calibration are analyzed and a linear range has been established,
- Zero point and single point calibration standards are analyzed with each batch
- A standard corresponding to the LOQ is analyzed with the batch and meets the established acceptance criteria
- The linearity is verified at the frequency established by the method or manufacturer.

6.2.8.3. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if the lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.8.4. During the course of analysis, the calibration curve is periodically verified by the analysis of calibration verification standards (CCV). A calibration verification standard is analyzed within each analytical batch at method/program specific intervals to verify that the initial calibration is still valid. The CCV is also analyzed at the end of the analytical batch.

6.2.8.5. A calibration blank is also run with each calibration verification standard to verify the cleanliness of the system. All reported results must be bracketed by acceptable CCVs. Instrument and method specific calibration acceptance criteria are explained within the specific analytical standard operating procedures for each facility.

6.2.8.6. Interference check standards are also analyzed per method requirements and must meet acceptance criteria for metals analyses.

6.3. Support Equipment Calibration Procedures

6.3.1. All support equipment is calibrated or verified at least annually using NIST traceable references over the entire range of use. The results of calibrations or verifications must be within the specifications required or the equipment will be removed from service until repaired. The laboratory maintains records to demonstrate the correction factors applied to working thermometers.

6.3.2. On each day the equipment is used, balances, ovens, refrigerators (those used to keep samples and standards at required temperatures), freezers, and water baths are checked in the expected use range with NIST traceable references in order to ensure the equipment meets laboratory specifications and these checks are documented appropriately.

6.3.3. Analytical Balances

6.3.3.1. Each analytical balance is calibrated or verified at least annually by a qualified service technician. The calibration of each balance is verified each day of use with weights traceable to NIST bracketing the range of use. Calibration weights are ASTM Class 1 or other class weights that have been calibrated against a NIST standard weight and are re-certified every 5 years at a minimum against a NIST traceable reference. Some accrediting agencies may require more frequent checks. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the Quality department.

6.3.4. Thermometers

6.3.4.1. Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, every 3 years with equipment directly traceable to NIST.

6.3.4.2. Working thermometers are compared with the reference thermometers annually according to corporate metrology procedures. Each thermometer is individually numbered and assigned a correction factor based on the NIST reference source. In addition, working thermometers are visually inspected by laboratory personnel prior to use and temperatures are documented.

6.3.4.3. Laboratory thermometer inventory and calibration data are maintained in the Quality department.

6.3.5. **pH/Electrometers**

6.3.5.1. The meter is calibrated before use each day, using fresh buffer solutions. See method SOP S-MN-I-526 – **Measurement of pH in Water, Soil and Waste**, or its equivalent revision or replacement.

6.3.6. **Spectrophotometers**

6.3.6.1. During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) and continuing calibration verification (CCV) standards.

6.3.7. **Mechanical Volumetric Dispensing Devices**

6.3.7.1. Mechanical volumetric dispensing devices including bottle top dispensers (those that are critical in measuring a required amount of reagent), pipettes, and burettes, excluding Class A volumetric glassware, are checked for accuracy on a quarterly basis. Glass microliter syringes are checked for accuracy prior to initial use.

6.3.7.2. Additional information regarding calibration and maintenance of laboratory support equipment can be found in SOP S-MN-Q-264 **Support Equipment** or its equivalent revision or replacement.

6.4. Instrument/Equipment Maintenance

6.4.1. The objectives of the Pace Analytical maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs.

6.4.2. The Operations Manager and/or department manager/supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems, and coordinate instrument repair and maintenance. Analysts have the primary responsibility to perform routine maintenance.

6.4.3. To minimize downtime and interruption of analytical work, preventative maintenance is routinely performed on each analytical instrument. Up-to-date instructions on the use and maintenance of equipment are available to staff in the department where the equipment is used.

6.4.4. Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that are subject to frequent failure, have limited lifetimes, or cannot be obtained in a timely manner should a failure occur.

6.4.5. All major equipment and instrumentation items are uniquely identified to allow for traceability. Equipment/instrumentation is, unless otherwise stated, identified as a system and not as individual pieces. The laboratory maintains equipment records that include the following:

- The name of the equipment and its software
- The manufacturer's name, type, and serial number
- Approximate date received and date placed into service
- Current location in the laboratory
- Condition when received (new, used, etc.)

- Copy of any manufacturer's manuals or instructions
- Dates and results of calibrations and next scheduled calibration (if known)
- Details of past maintenance activities, both routine and non-routine
- Details of any damage, modification or major repairs

6.4.6. All instrument maintenance is documented in maintenance logbooks that are assigned to each particular instrument or system.

6.4.7. The maintenance log entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

6.4.8. Any equipment that has been subjected to overloading or mishandling, or that gives suspect results, or has been shown to be defective, is taken out of service and clearly identified. The equipment shall not be used to analyze customer samples until it has been repaired and shown to perform satisfactorily.

7.0. CONTROL OF DATA

Analytical results processing, verification, and reporting are procedures employed that result in the delivery of defensible data. These processes include, but are not limited to, calculation of raw data into final concentration values, review of results for accuracy, evaluation of quality control criteria and assembly of technical reports for delivery to the data user.

All analytical data undergo a well-defined, well-documented multi-tier review process prior to being reported to the customer. This section describes procedures used by PASI for translating raw analytical data into accurate final sample reports as well as PASI data storage policies.

7.1. Analytical Results Processing

7.1.1. When analytical, field, or product testing data is generated, it is either recorded in a bound laboratory logbook (e.g., Run log or Instrument log) or copies of computer-generated printouts that are appropriately labeled and filed. These logbooks and other laboratory records are kept in accordance with each facility's Standard Operating Procedure for documentation storage and archival. If the laboratory chooses to minimize or eliminate its paper usage, these records can be kept on electronic media. In this case, the laboratory must ensure that there are sufficient redundant electronic copies so no data is lost due to unforeseen computer issues.

7.1.2. The primary analyst is responsible for initial data reduction and review. This includes confirming compliance with required methodology, verifying calculations, evaluating quality control data, noting non-conformances in logbooks or as footnotes or narratives, and uploading analytical results into the LIMS. The primary analyst must be clearly identified in all applicable logbooks, spreadsheets and LIMS fields.

7.1.3. The primary analyst then compiles the initial data package for verification. This compilation must include sufficient documentation for data review. It may include standard calibrations, chromatograms, manual integration documentation, electronic printouts, chain of custody forms, and logbook copies.

7.1.4. Some agencies or customers require different levels of data reporting. For these special levels, the primary analyst may need to compile additional project information, such as initial calibration data or extensive spectral data, before the data package proceeds to the verification step.

7.2. Data Verification

7.2.1. Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any non-conformances are properly documented.

7.2.2. Analysts performing the analysis and subsequent data reduction have primary responsibility for quality of the data produced. The primary analyst initiates the data verification process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review checklists, either hardcopy or electronic, are used to document the data review process. The primary analyst is responsible for the initial input of the data into the LIMS. The primary analyst and reviewer must be clearly identified on all applicable data review checklists.

7.2.3. The completed data package is then sent to a designated qualified reviewer (this cannot be the primary analyst). The following criteria have been established to qualify someone as a data reviewer. To perform secondary data review, the reviewer must:

7.2.3.1. Have a current Demonstration of Capability (DOC) study on file and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, See Note

7.2.3.2. Have a DOC on file for a similar method/technology (i.e., GC/MS) and have an SOP acknowledgment form on file for the method/procedure being reviewed; or, See Note

7.2.3.3. Supervise or manage a Department and have an SOP acknowledgment form on file for the method/procedure being reviewed; or,

7.2.3.4. Have significant background in the department/methods being reviewed through education or experience and have an SOP acknowledgment form on file for the method/procedure being reviewed.

7.2.4. **Note:** Secondary reviewer status must be approved personally by the SQM/QM or SGM/GM/AGM/OM in the event that this person has no prior experience on the specific method or general technology.

7.2.5. This reviewer provides an independent technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This assessment involves a quality control review for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. The reviewer validates the data entered into the LIMS and documents approval of manual integrations.

7.2.6. Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data (or designating the review of data electronically). The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.

7.2.7. Additional information regarding data review procedures can be found in SOP S-MN-L-132 **Data Reduction, Validation and Reporting in the Environmental Lab** or its equivalent revision or replacement, as well as in SOP S-MN-Q-214 **Manual Integration** or its equivalent revision or replacement.

7.2.8. The Data Checker program will process validated data for a given project against a set of pre-determined requirements and known chemistry relationships. The program creates a report that includes a series of warnings and errors for any requirement or condition determined to be suspect or incorrect. These warnings and error counts are displayed on the "Project Inquiry by Client" screen and on the final Data Checker reports. For projects that have any number of warnings or errors, the Data Checker report will provide a message that identifies the source and condition of the error or warning.

7.2.9. Some reports and/or data packages may be reviewed by the QM or SQM or designee based on program requirements (e.g., DoD) or client requirements. In this case a thorough review for completeness and accuracy may include a compilation of raw data and QC summaries in addition to the final report to produce a full deliverable package. In the case of DoD, 100% of all packages must have a final administrative review (to confirm that primary and secondary reviews were completed and documented and that data packages are complete) and 10% of all data packages must be reviewed by the Quality Manager for technical completeness/accuracy. This 10% review can be done after the data

packages have been submitted to the clients. See SOP S-MN-Q-271(or equivalent replacement), **Audits and Inspections**, for full Quality department final report and raw data review requirements.

7.3. Data Reporting

7.3.1. Data for each analytical fraction pertaining to a particular PASI project number are delivered to the Project Manager for assembly into the final report. All points mentioned during technical and QC reviews are included in a case narrative if there is potential for data to be impacted.

7.3.2. Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy or electronic deliverable. A standard PASI final report consists of the following components:

7.3.2.1. A title which designates the report as "Final Report", "Laboratory Results", "Certificate of Results", etc.;

7.3.2.2. Name and address of laboratory (or subcontracted laboratories, if used);

7.3.2.3. Phone number and name of laboratory contact to where questions can be referred;

7.3.2.4. A unique identification number for the report. The pages of the report shall be numbered and a total number of pages shall be indicated;

7.3.2.5. Name and address of customer and name of project;

7.3.2.6. Unique identification of samples analyzed as well as customer sample IDs;

7.3.2.7. Identification of any sample that did not meet acceptable sampling requirements of the relevant governing agency, such as improper sample containers, holding times missed, sample temperature, etc.;

7.3.2.8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less;

7.3.2.9. Identification of the test methods used;

7.3.2.10. Identification of sampling procedures if sampling was conducted by the laboratory;

7.3.2.11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data;

7.3.2.12. Identification of whether calculations were performed on a dry or wet-weight basis;

7.3.2.13. Reporting limits used;

7.3.2.14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.;

7.3.2.15. A signature and title, electronic or otherwise, of person accepting responsibility for the content of the report;

7.3.2.16. Date report was issued;

7.3.2.17. A statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory;

7.3.2.18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory;

7.3.2.19. Identification of all test results provided by a subcontracted laboratory or other outside source;

7.3.2.20. Identification of results obtained outside of quantitation levels.

In addition to the requirements listed above, final reports shall also contain the following items when necessary for the interpretation of results:

7.3.2.21. Deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions;

7.3.2.22. Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g., the TNI standard);

7.3.2.23. Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit;

7.3.2.24. Where appropriate and needed, opinions and interpretations, which may include opinions on the compliance/non-compliance of the results with requirements, fulfillment of contractual requirements, recommendations on how to use the results, and guidance to be used for improvement;

7.3.3. Additional items may be required per Client QAPPs or different state regulations. Ohio VAP requires an Affidavit that must summarize if there are any exceptions to what has been reported, this includes, but is not limited to, itemizing any analytes that the laboratory is not approved for under the VAP program. Any analytes reported that are not part of a scope of accreditation or approval program must be clearly indicated on the final report and associated paperwork such as an Affidavit.

7.3.4. For DoD labs, in reference to item 7.3.2.8 listed above, both date and time of preparation and analysis are considered essential information, regardless of the length of the holding time, and shall be included as part of the laboratory report.

7.3.5. Any changes made to a final report shall be designated as "Revised" or equivalent wording. The laboratory must keep sufficient archived records of all laboratory reports and revisions. For higher levels of data deliverables, a copy of all supporting raw data is sent to the customer along with a final report of results. When possible, the PASI facility will provide electronic data deliverables (EDD) as required by contracts or upon customer request.

7.3.6. Customer data that requires transmission by telephone, telex, facsimile or other electronic means undergoes appropriate steps to preserve confidentiality.

7.3.7. The following positions are the only approved signatories for PASI final reports:

- Senior General Manager
- General Manager
- Assistant General Manager
- Senior Quality Manager
- Quality Manager
- Client Services Manager
- Project Manager

- Project Coordinator

7.4. Data Security

7.4.1. All data including electronic files, logbooks, extraction/digestion/distillation worksheets, calculations, project files and reports, and any other information used to produce the technical report are maintained secured and retrievable by the PASI facility.

7.5. Data Archiving

7.5.1. All records compiled by PASI are maintained legible and retrievable and stored secured in a suitable environment to prevent loss, damage, or deterioration by fire, flood, vermin, theft, and/or environmental deterioration. Records are retained for a minimum of five years unless superseded by federal, state, contractual, and/or accreditation requirements. These records may include, but are not limited to, customer data reports, calibration and maintenance of equipment, raw data from instrumentation, quality control documents, observations, calculations, and logbooks. These records are retained in order to provide for possible historical reconstruction including sampling, receipt, preparation, analysis, and personnel involved. TNI-related records will be made readily available to accrediting authorities. Access to archived data is documented and controlled by the SQM/QM or a designated Data Archivist.

7.5.2. Records that are computer generated have either a hard copy or electronic write protected backup copy. Hardware and software necessary for the retrieval of electronic data is maintained with the applicable records. Archived electronic records are stored protected against electronic and/or magnetic sources.

7.5.3. In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In the event of bankruptcy, laboratory reports and/or records will be transferred to the customer and/or the appropriate regulatory entity upon request.

7.6. Data Disposal

7.6.1. Data that has been archived for the facility's required storage time may be disposed of in a secure manner by shredding, returning to customer, or utilizing some other means that does not jeopardize data confidentiality. Records of data disposal will be archived for a minimum of five years unless superseded by federal, contractual, and/or accreditation requirements. Data disposal includes any preliminary or final reports that are disposed.

7.6.2. For Ohio VAP labs, all documents and data prepared or acquired in connection to VAP work must be retained for a period of 10 years after the data of reporting. After 10 years, if the laboratory wishes to dispose of the records, the laboratory must notify the VAP agency by certified mail of such intent and provide the agency an opportunity to request the materials from Pace. The documents must not be disposed of until notification has been received in response to the Pace request for disposal.

8.0. QUALITY SYSTEM AUDITS AND REVIEWS

8.1. Internal Audits

8.1.1. Responsibilities

8.1.1.1. The SQM/QM is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The SQM/QM evaluates audit observations and verifies the completion of corrective actions. In addition, a periodic corporate audit will be conducted. The corporate audits will focus on the effectiveness of the Quality System as outlined in this manual but may also include other quality programs applicable to an individual laboratory.

8.1.2. Scope and Frequency of Internal Audits

8.1.2.1. The complete internal audit process consists of the following four sections:

- Raw Data Review audits- conducted according to a schedule per local SQM/QM. A certain number of these data review audits are conducted per quarter to accomplish this yearly schedule;
- Quality System audits- considered the traditional internal audit function and includes analyst interviews to help determine whether practice matches method requirements and SOP language;
- Final Report reviews;
- Corrective Action Effectiveness Follow-up.

8.1.2.2. Internal systems audits are conducted yearly at a minimum. The scope of these audits includes evaluation of specific analytical departments or a specific quality related system as applied throughout the laboratory.

8.1.2.3. Where the identification of non-conformities or departures cast doubt on the laboratory's compliance with its own policies and procedures, the lab must ensure that the appropriate areas of activity are audited as soon as possible. Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures, training documents, Quality Assurance Manual, and all applicable addenda
- Data records and non-technical documents
- Personnel and training files.
- General laboratory safety protocols.
- Chemical handling practices, such as labeling of reagents, solutions, and standards as well as all associated documentation.
- Documentation concerning equipment and instrumentation, calibration/maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.

- General procedures for data security, review, documentation, reporting, and archiving.
- Data integrity issues such as proper manual integrations.

8.1.2.4. When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Detection limit studies
- Internal chain of custody documentation
- Documentation of standard preparations
- Quality Control limits and Control charts

8.1.2.5. Certain projects may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPPs, etc.

8.1.2.6. A representative number of data audits are completed annually. Findings from these data audits are handled in the same manner as those from other internal and external audits.

8.1.2.7. The laboratory, as part of their overall internal audit program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery and reporting of potential data integrity issues are handled in a confidential manner. All investigations that result in findings of inappropriate activity are fully documented, including the source of the problem, the samples and customers affected the impact on the data, the corrective actions taken by the laboratory, and which final reports had to be re-issued. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed.

8.1.3. Internal Audit Reports and Corrective Action Plans

8.1.3.1. Additional information can be found in SOP S-MN-Q-271 **Internal and External Audits** or its equivalent revision or replacement.

8.1.3.2. A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the SQM/QM writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

8.1.3.3. When audit findings cast doubt on the effectiveness of the operations or on the correctness of validity of the laboratory's environmental test results, the laboratory will take timely corrective action and notify the customer in writing within three business days, if investigations show that the laboratory results may have been affected.

8.1.3.4. Once completed, the internal audit report is issued jointly to the SGM/GM/AGM/OM and the manager(s)/supervisor(s) of the audited operation at a minimum. The responsible manager(s)/supervisor(s) responds within 14 days with a proposed plan to correct all of the deficiencies cited in the audit report. The SQM/QM may grant additional time for responses to large or complex deficiencies (not to exceed 30 days). Each response must include timetables for completion of all proposed corrective actions.

8.1.3.5. The SQM/QM reviews the audit responses. If the response is accepted, the SQM/QM uses the action plan and timetable as a guideline for verifying completion of the corrective action(s). If

the SQM/QM determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

8.1.3.6. To complete the audit process, the SQM/QM performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. This is usually within 60-90 days after implementation. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

8.2. External Audits

8.2.1. PASI laboratories are audited regularly by regulatory agencies to maintain laboratory certifications and by customers to maintain appropriate specific protocols.

8.2.2. Audit teams external to the company review the laboratory to assess the effectiveness of systems and degree of technical expertise. The SQM/QM and other QA staff host the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process.

8.2.3. The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the SQM/QM. The SGM/GM/AGM/OM provides the necessary resources for staff to develop and implement the corrective action plans. The SQM/QM collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The SQM/QM follows-up with the laboratory staff to ensure corrective actions are implemented and that the corrective action was effective.

8.3. Quarterly Quality Reports

8.3.1. The SQM/QM is responsible for preparing a quarterly report to management summarizing the effectiveness of the laboratory Quality Systems. This status report will include:

- Overview of quality activities for the quarter
- Certification status
- Proficiency Testing study results
- SOP revision activities
- Internal audit (method/system) findings
- Manual integration audit findings (Mintminer)
- Raw Data and Final Report review findings
- MDL activities
- Other significant Quality System items

8.3.2. The Corporate Director of Quality utilizes the information from each laboratory to make decisions impacting the quality program compliance of the company as a whole. Each SGM/GM/AGM/OM utilizes the quarterly report information to make decisions impacting Quality Systems and operational systems at a local level.

8.3.3. Additional information can be found in SOP S-ALL-Q-014 **Quality System Review** or its equivalent revision or replacement.

8.4. Annual Managerial Review

8.4.1. A managerial review of Quality Systems is performed on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

8.4.2. The managerial review must include the following topics of discussion:

- Suitability of quality management policies and procedures
- Manager/Supervisor reports
- Internal audit results
- Corrective and preventive actions
- External assessment results
- Proficiency testing studies
- Sample capacity and scope of work changes
- Customer feedback, including complaints
- Recommendations for improvement,
- Other relevant factors, such as quality control activities, resources, and staffing.

8.4.3. This managerial review must be documented for future reference by the SQM/QM and copies of the report are distributed to laboratory staff. Results must feed into the laboratory planning system and must include goals, objectives, and action plans for the coming year. The laboratory shall ensure that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

8.5. Customer Service Reviews

8.5.1. As part of the annual managerial review listed previously, the sales staff is responsible for reporting on customer feedback, including complaints. The acquisition of this information is completed by performing surveys.

8.5.2. The sales staff continually receives customer feedback, both positive and negative, and reports this feedback to the laboratory management in order for them to evaluate and improve their management system, testing activities and customer service.

8.5.3. In addition, the labs must be willing to cooperate with customers or their representatives to clarify customer requests and to monitor the laboratory's performance in relation to the work being performed for the customers. This cooperation may include providing the customer reasonable access to relevant areas of the lab for the witnessing of tests being performed; or the preparation of samples or data deliverables to be used for verification purposes.

8.5.4. Customer service is an important aspect to Pace's overall objective of providing a quality product. Good communication should be provided to the customer's throughout projects. The lab should inform the customer of any delay or major deviations in the performance of analytical tests.

9.0. CORRECTIVE ACTION

Additional information can be found in SOP S-MN-Q-262 **Corrective and Preventive Actions** or its equivalent revision or replacement.

During the process of sample handling, preparation, and analysis, or during review of quality control records, or during reviews of non-technical portions of the lab, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The Quality System of PASI provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This can be done using PASI's LabTrack system that lists among at a minimum, the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

9.1. Corrective Action Documentation

9.1.1. The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal Laboratory Non-Conformance Trends
- PE/PT Sample Results
- Internal and External Audits
- Data or Records Review (including non-technical records)
- Client Complaints
- Client Inquiries
- Holding Time violations

9.1.2. Documentation of corrective actions may be in the form of a comment or footnote on the final report that explains the deficiency (e.g., matrix spike recoveries outside of acceptance criteria) or it may be a more formal documentation (either paper system or computerized spreadsheet). This depends on the extent of the deficiency, the impact on the data, and the method or customer requirements for documentation.

9.1.3. The person who discovers the deficiency or non-conformance initiates the corrective action documentation on the Non-Conformance Corrective/ Preventive Action report and/or LabTrack. The documentation must include the affected projects and sample numbers, the name of the applicable Project Manager, the customer name, and the sample matrix involved. The person initiating the corrective action documentation must also list the known causes of the deficiency or non-conformance as well as any corrective/preventative actions that they have taken. Preventive actions must be taken in order to prevent or minimize the occurrence of the situation.

9.1.4. In the event that the laboratory is unable to determine the cause, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample through the process looking at each individual step in detail. The root cause must be documented within LabTrack or on the Corrective/Preventive Action Report.

9.1.5. After all the documentation is completed, the routing of the Corrective/Preventive Action Report and /or LabTrack will continue from the person initiating the corrective action, to their immediate supervisor or the applicable Project Manager and finally to the SQM/QM, if applicable, who may be responsible for final review and signoff of corrective/preventive actions.

9.1.6. In the event that analytical testing or results do not conform to documented laboratory policies or procedures, customer requirements, or standard specifications, the laboratory shall investigate the significance of the non-conformance and document appropriate corrective actions. The proper level of laboratory management will review any departure from these requirements for technical suitability. These departures are permitted only with the approval of the SGM/GM/AGM/OM or the SQM/QM. Where necessary, Project Management will notify the customer of the situation and will advise of any ramifications to data quality (with the possibility of work being recalled). The procedures for handling non-conforming work are detailed in SOP S-MN-Q-262 **Corrective and Preventive Actions** or its equivalent revision or replacement.

9.2. Corrective Action Completion

9.2.1. Internal Laboratory Non-Conformance Trends

9.2.1.1. There are several types of non-conformance trends that may occur in the laboratory that would require the initiation of a corrective action report. Laboratories may choose to initiate a corrective action for all instances of one or more of these categories if they so choose, however the intent is that each of these would be handled according to its severity; one time instances could be handled with a footnote or qualifier whereas a systemic problem with any of these categories may require an official corrective action process. These categories, as defined in the Corrective Action SOP are as follows:

- Login error
- Preparation Error
- Contamination
- Calibration Failure
- Internal Standard Failure
- LCS Failure
- Laboratory accident
- Spike Failure
- Instrument Failure
- Final Reporting error

9.2.2. PE/PT Sample Results

9.2.2.1. Any PT result assessed as "not acceptable" requires an investigation and applicable corrective actions. The operational staff is made aware of the PT failures and they are responsible for reviewing the applicable raw data and calibrations and list possible causes for error. The SQM/QM reviews their findings and initiates another external PT sample or an internal PT sample to try and correct the previous failure. Replacement PT results must be monitored by the SQM/QM and reported to the applicable regulatory authorities.

9.2.3. Internal and External Audits

9.2.3.1. The SQM/QM is responsible for documenting all audit findings and their corrective actions. This documentation must include the initial finding, the persons responsible for the corrective action, the due date for responding to the auditing body, the root cause of the finding, and

the corrective actions needed for resolution. The SQM/QM is also responsible for providing any back-up documentation used to demonstrate that a corrective action has been completed.

9.2.4. **Data Review**

9.2.4.1. In the course of performing primary and secondary review of data or in the case of raw data reviews (e.g., by the SQM/QM), errors may be found which require corrective actions. Any finding that affects the quality of the data requires some form of corrective action, which may include revising and re-issuing of final reports.

9.2.5. **Client Complaints**

9.2.5.1. Project Managers are responsible for issuing corrective action forms, when warranted, for customer complaints. As with other corrective actions, the possible causes of the problem are listed and the form is passed to the appropriate analyst or supervisor for investigation. After potential corrective actions have been determined, the Project Manager reviews the corrective action form to ensure all customer needs or concerns are being adequately addressed.

9.2.6. **Client Inquiries**

9.2.6.1. When an error on the customer report is discovered, the Project Manager is responsible for initiating a formal corrective action form that describes the failure (e.g., incorrect analysis reported, reporting units are incorrect, or reporting limits do not meet objectives). The Project Manager is also responsible for revising the final report if necessary and submitting it to the customer.

9.2.7. **Holding Time Violations**

9.2.7.1. In the event that a holding time has been missed, the analyst or supervisor must complete a formal corrective action form. The Project Manager and the SQM/QM must be made aware of all holding time violations.

9.2.7.2. The Project Manager must contact the customer in order that appropriate decisions are made regarding the hold time excursion and the ultimate resolution is then documented and included in the customer project file. The SQM/QM includes a list of all missed holding times in their Quarterly Report to the corporate quality office.

9.3. Preventive Action Documentation

9.3.1. Pace laboratories can take advantage of several available information sources in order to identify needed improvements in all of their systems including technical, managerial, and quality. These sources may include:

- Management Continuous Improvement Plan (CIP) metrics which are used by all production departments within Pace. When groups compare performance across the company, ways to improve systems may be discovered. These improvements can be made within a department or laboratory-wide.
- Annual managerial reviews- part of this TNI-required and NVLAP-required review is to look at all processes and procedures used by the laboratory over the past year and to determine ways to improve these processes in the future.
- Quality systems reviews- any frequent checks of quality systems (monthly logbook reviews, etc.) can uncover issues that can be corrected or adjusted before they become a larger issue.

9.3.2. When improvement opportunities are identified or if preventive action is required, the laboratory can develop, implement, and monitor preventive action plans.

10.0. GLOSSARY

The source of some of the definitions is indicated previous to the actual definition (e.g., TNI, DoD).

3P Program	The Pace Analytical continuous improvement program that focuses on Process, Productivity, and Performance. Best Practices are identified that can be used by all PASI labs.
Acceptance Criteria	TNI and DoD- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI and DoD- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.
Accrediting Authority	DoD- The Territorial, State or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Accrediting (or Accreditation) Body	DoD- Authoritative body that performs accreditation.
Accuracy	TNI and DoD- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI and DoD- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria. Note: In this standard (DoD), assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	DoD- A process in which a sample is converted to free atoms.

Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. DoD- A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity.
Batch	TNI and DoD- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples. South Carolina- same definition as TNI except 24 hours should be changed to 8 hours.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample	DoD- A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.
Calibration	TNI and DoD- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. DoD- The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	DoD- A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration. DoD- A substance or reference material used to calibrate an instrument.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. DoD- A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.
Chain of Custody	DoD- An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of custody Form (COC)	TNI and DoD- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	DoD- Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI and DoD- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.
Conformance	DoD- An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Congener	DoD- A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.
Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Data Audit	DoD- A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e. that they meet specified acceptance criteria).
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.

Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form. DoD- The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.
Definitive Data	DoD- Analytical data of known quality, concentration and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making.
Demonstration of Capability	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate acceptable accuracy.
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate is 1%.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.
Document Control	DoD- The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	DoD- The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	DoD- A solvent used to carry the components of a mixture through a stationary phase.
Elute	DoD- To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	DoD- A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	DoD- The process of measuring or collecting environmental data.

Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	DoD- An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence.
False Positive	DoD- An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition. Note: For DoD, the finding must be linked to a specific requirement.
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.

Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	DoD- One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.

Initial Calibration Verification (ICV)	DoD- A standard obtained or prepared from a source independent of the source of the standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration.
Inspection	DoD- An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.
Instrument Blank	DoD- A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	DoD- Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	DoD- Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standards	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	DoD- The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	DoD- One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	DoD- A body that calibrates and/or tests.
Laboratory Control Sample (LCS)	TNI and DoD- (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	DoD- Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
LabTrack	Database used by Pace Analytical to store and track corrective actions and other laboratory issues.
Learning Management System (LMS)	A training database used by Pace Analytical to train their employees. This system is a self-paced system which is capable of tracking all employee training requirements and documentation.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD)	TNI- A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. DoD- The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Lot	A quantity of bulk material of similar composition processed or manufactured at the same time.
Management	DoD- Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	DoD- System to establish policy and objectives and to achieve those objectives.
Manager (however named)	DoD- The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI and DoD- The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.

Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. DoD- A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI and DoD- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement System	TNI and DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI and DoD- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL)	DoD- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	DoD- A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
MintMiner	Program used by Pace Analytical to review large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	DoD- Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	DoD- An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Performance Audit	DoD- The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	DoD- Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI and DoD- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI- Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. DoD- Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.
Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing	TNI and DoD- A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Program	TNI and DoD- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.

Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria. DoD- A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.
Protocol	TNI and DoD- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client. DoD- An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	DoD- A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. DoD- The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of the users.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. DoD- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking.
Quality Manual	TNI and DoD- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quality System Matrix	TNI and DoD- These matrix definitions are to be used for purposes of batch and quality control requirements: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. DoD- Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank)	DoD- A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. DoD- A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location. DoD- A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.
Reference Toxicant	DoD- The toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e. statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (or otherwise named)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	DoD- Denotes a mandatory specification; often designated by the term "shall".
Retention Time	DoD- The time between sample injection and the appearance of a solute peak at the detector.
Sample	DoD- Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by Pace Analytical sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).

Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selective Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. DoD- The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances.
Sensitivity	TNI and DoD- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	DoD- Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	DoD- Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio	DoD- The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude.
Spike	DoD- A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI and DoD- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard (Chemical)	DoD- Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	DoD- A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. DoD- A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	DoD- A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Supervisor	DoD- The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes specifically named by a client (also called project-specific analytes).
Technical Director	DoD- Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Test	DoD- A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.

Test Method	DoD- An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. DoD- The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	DoD- A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty Measurement	The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte).
Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification	TNI and DoD- Confirmation by examination and objective evidence that specified requirements have been met. Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).
Work Cell	DoD- A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented.

11.0. REFERENCES

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11.7. "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.

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11.11. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

11.12. Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.

11.13. Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.

11.14. Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

11.15. Requirements for Quality Control of Analytical Data for the Environmental Restoration Program, Martin Marietta, ES/ER/TM-16, December, 1992.

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11.17. National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards. Most recent version.

11.18. ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.

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12.0. REVISIONS

The PASI Corporate Quality Office files both a paper copy and electronic version of a Microsoft Word document with tracked changes detailing all revisions made to the previous version of the Quality Assurance Manual. This document is available upon request. All revisions are summarized in the table below.

Document Number	Reason for Change	Date
Quality Assurance Manual 16.0	Section 2.6.5: added VM/Duluth. Sections 2.7.1.3 and 2.7.2.2: added SOT references. Section 4.1.2: added parenthetical phrase directing the reader to the glossary section. Section 4.1.3: added language from old section 4.1.4 and deleted language in order to match current practices. Section 4.1.4: .reworded for clarity. Also added last sentence in red text to allow labs to insert additional method blank requirements. Sections 4.1.7, 4.2.9, 4.4.4, and 6.2.7.8: revised wording per updated Ohio VAP requirements. Sections 4.5.2 and 4.6.1: added 'calibration standard' to list of QC items that require the addition of surrogates and internals. Also added red letter text for additional lab-specific information. Section 4.5.2.2. - added Section 4.10.3: fixed LOQ verification language to match TNI standard (V1M4, section 1.5.2.2.c). Old section 4.12.2: deleted. Covered in reference in current section 4.12.5. Section 6.2.3: moved language that had been in the 'organic calibration only' section to this general calibration section. The language in this section applies to both organic and inorganic tests. Section 6.2.7.3: added clarification statement regarding the calibration verification standard. Section 6.3.7.1: reworded for clarity and added red letter text for calibration of micro-liter syringes. Section 7.2.5: added language specifying secondary reviewer documents approval of manual integrations. Section 7.2.7: added reference to the Manual Integration SOP. Section 7.2.8: added new red-letter text language to match Data Checker SOP. Section 7.2.9: added new red-letter text language to comply with DoD QSM 4.2. 7.3.3. – further clarified Section 8.3.1: deleted items in order to match current SOP S-ALL-Q-014. Added red-letter text to the following sections for Ohio VAP labs: 2.5.2.1, 4.5.2.1, 4.6.3, and 7.6.2. Attachment II-VI – updated Attachment VI: added red letter text under title to satisfy AZ state requirement. Attachment VIII, Analyte Chart: changed holding times expressed as '6 Months' to '180 Days' to match actual practice as defined by LIMS acodes. Attachment VIII, Analyte Chart: added explanation under the header to explain the holding times expressed in the chart.	05Feb2013

ATTACHMENT I- QUALITY CONTROL CALCULATIONS

PERCENT RECOVERY (%REC)

$$\%REC = \frac{(MSConc - SampleConc)}{TrueValue} * 100$$

NOTE: The SampleConc is zero (0) for theLCS and Surrogate Calculations

PERCENT DIFFERENCE (%D)

$$\%D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:
TrueValue = Amount spiked (can also be the $\overline{CF}$ or $\overline{RF}$ of the ICAL Standards)
Measured Value = Amount measured (can also be the CF or RF of the CCV)

PERCENT DRIFT

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentrtion} * 100$$

RELATIVE PERCENT DIFFERENCE (RPD)

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2)/2} * 100$$

where:
R1 = Result Sample 1
R2 = Result Sample 2

CORRELATION COEFFICIENT (R)

$$CorrCoeff = \frac{\sum_{i=1}^{N} W_i * (X_i - \overline{X}) * (Y_i - \overline{Y})}{\sqrt{\left(\sum_{i=1}^{N} W_i * (X_i - \overline{X})^2\right) * \left(\sum_{i=1}^{N} W_i * (Y_i - \overline{Y})^2\right)}}$$

With:		
	N	Number of standard samples involved in the calibration
	i	Index for standard samples
	Wi	Weight factor of the standard sample no. i
	Xi	X-value of the standard sample no. i
	X(bar)	Average value of all x-values
	Yi	Y-value of the standard sample no. i
	Y(bar)	Average value of all y-values

ATTACHMENT I- QUALITY CONTROL CALCULATIONS (CONTINUED)

STANDARD DEVIATION (S)

$$S = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{(n-1)}}$$

where:
n = number of data points
X_i = individual data point
$\overline{X}$ = average of all data points

AVERAGE ($\overline{X}$)

$$\overline{X} = \frac{\sum_{n=1}^{i} X_i}{n}$$

where:
n = number of data points
X_i = individual data point

RELATIVE STANDARD DEVIATION (RSD)

$$RSD = \frac{S}{\overline{X}} * 100$$

where:
S = Standard Deviation of the data points
$\overline{X}$ = average of all data points

INITIAL CALIBRATION CURVE FORMULAS

Average Response Factor:
Cx = Ax*Cis/Ais/RF

Linear Regression:
y = mx + b
Cx = (((Ax/Ais)-b)/m)*Cis

Quadratic Regression:
y = ax2 + bx + c
Cx = (SQRT(b2-(4*a*(c(Ax/Ais))))-b)/(2*a)*Cis

Where:

Using standard response curve:
Ax = native area
Cx = native concentration
Ais = Internal Standard area
Cis = Internal Standard concentration
RF = Response Factor

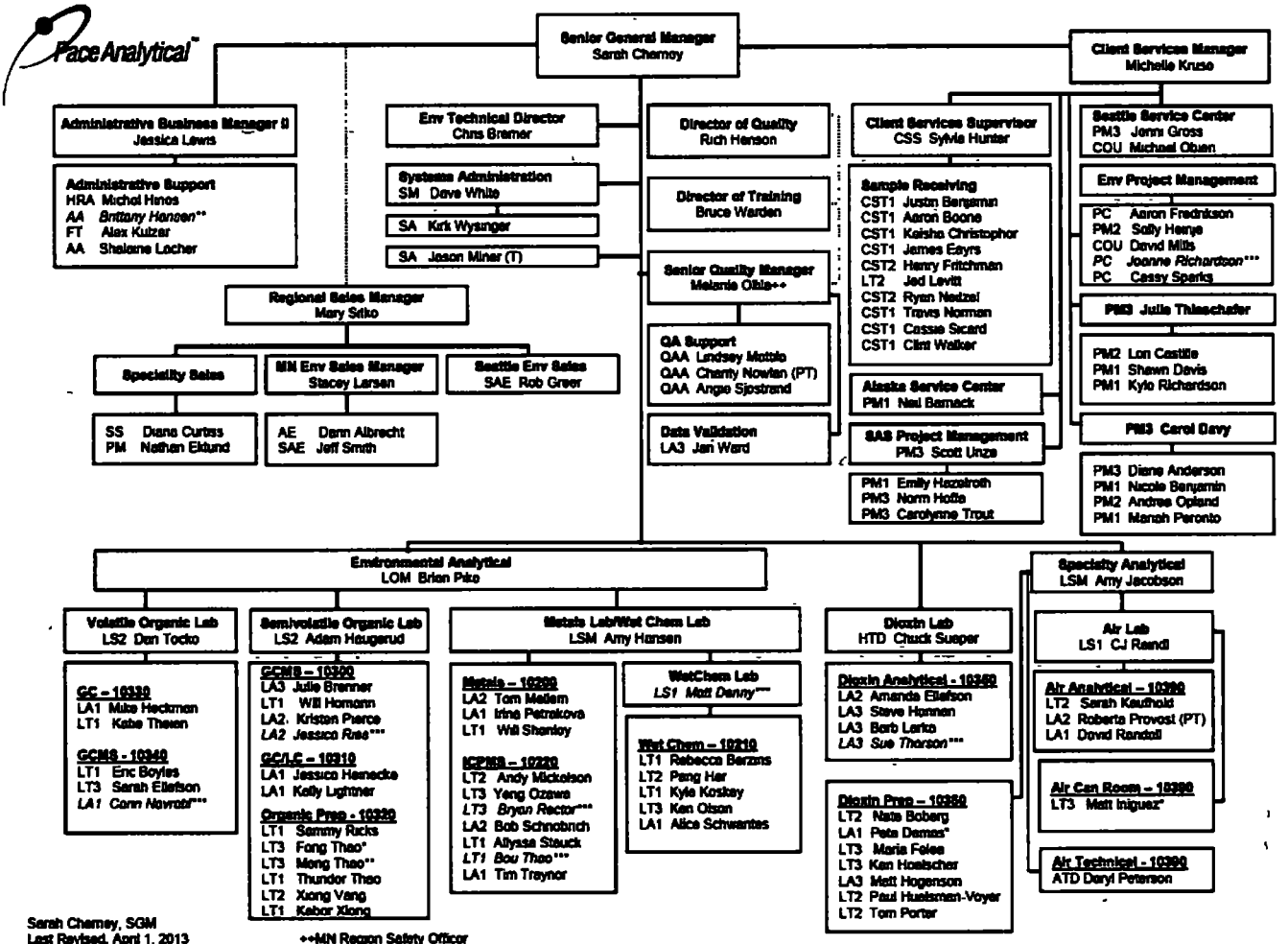
Using Target response curve:
X axis = Ax/Ais
Y axis = Cx/Cis

m = slope = [(Swxiyi*Sw)-(Swxi*Swyi)] / [(Sw*Swxi2)-(Swxi*Swxi)]

b = intercept = yAVE-(m*(xAVE))

Where:
xi = individual values for the independent variable
yi = individual values for the dependent variable
w = weighting factor, for equal or no weighting w = 1
xAVE = average of the x values
yAVE = average of the y values
S = the sum of all the individual values

ATTACHMENT IIA- MINNEAPOLIS LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



Sarah Charney, SGM
Last Revised. April 1, 2013
*Lead Analyst/Technician
(T) Temporary Employee

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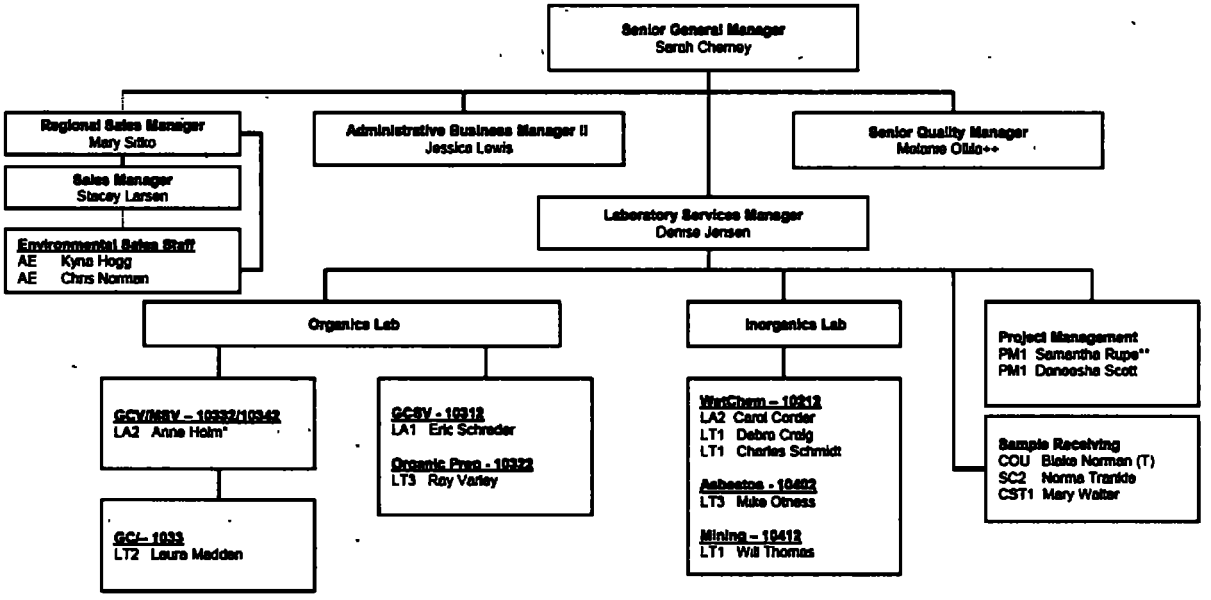
**Safety Officer/Waste Coordinator
***Safety Committee Member

Minneapolis, Minnesota Laboratory

ATTACHMENT IIB- MONTANA LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)

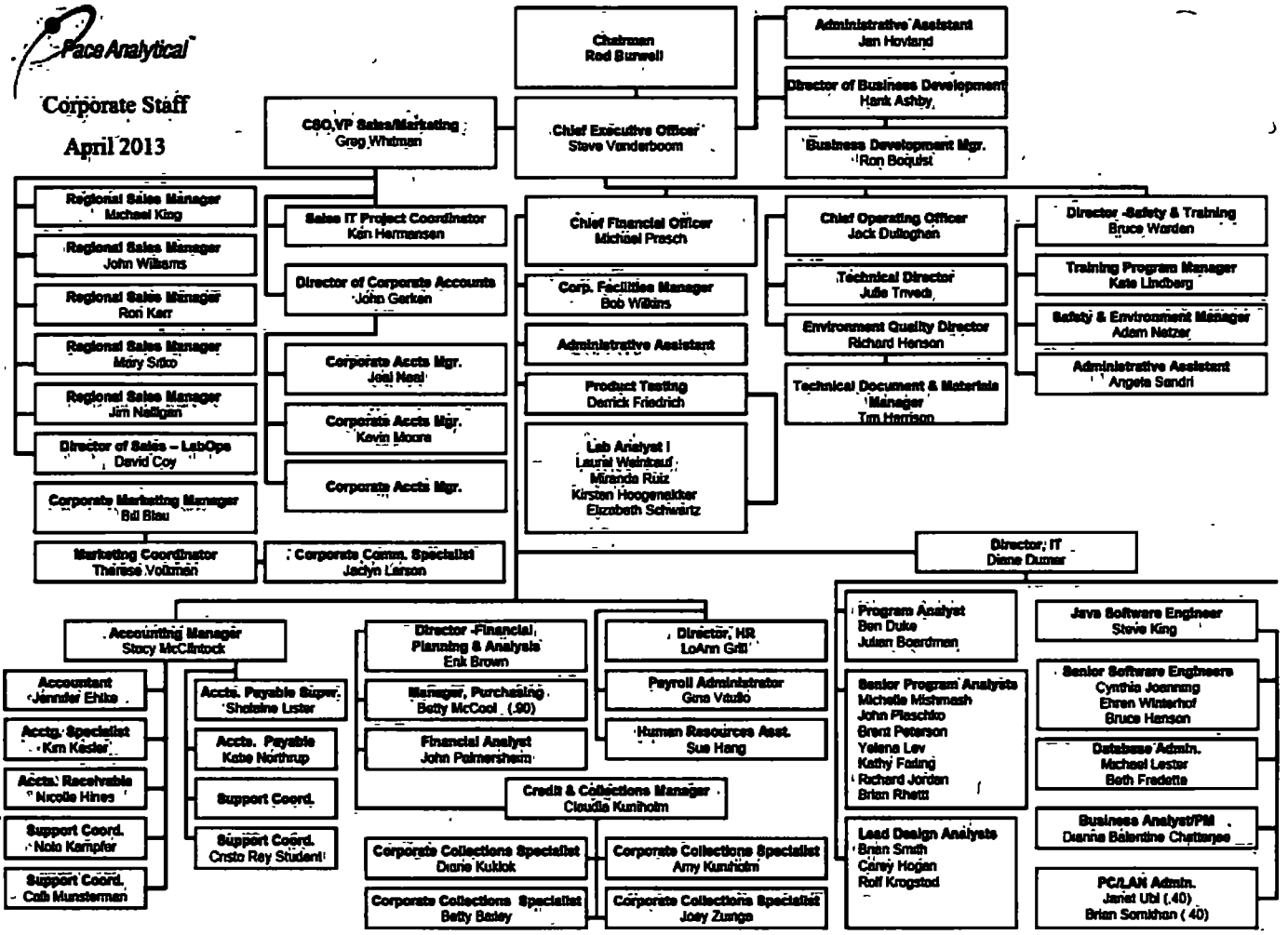
Pace Analytical™



Sarah Cherney, General Manager
Last Revised April 3, 2013
*Lead Analyst/Technician
**Safety Officer
(T) Temporary Employee

Billings, Montana Laboratory

ATTACHMENT IIC- CORPORATE ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Air	GC	10AIR0	Agilent Technologies	6890N	GC/MS	TO-15
Air	MS	10AIR0	Agilent Technologies	5973 Network	GC/MS	TO-15
Air	Concentrator	10AIR0	Entech Instruments, Inc.	7100A	GC/MS	TO-15
Air	GC	10AIR5	HP	5890	TCD	3C
Air	GC	10AIR7	Agilent Technologies	6890N	GC/MS	TO-15
Air	MS	10AIR7	Agilent Technologies	5973 Network	GC/MS	TO-15
Air	Concentrator	10AIR7	Entech Instruments, Inc.	7100A	GC/MS	TO-15
Air	GC	10AIR9	Agilent Technologies	G1530A	GC/FID/TCD	RSK 175
Air	Headspace Sampler	10AIR9	Agilent Technologies	G1888	GC/FID/TCD	RSK 175
Air	GCMS	10AIRA	ALS Ready	6890A	GC	TO3 BTEX
Air	Concentrator	10AIRA	Entech Instruments, Inc.	7100A	GC	TO3 BTEX
Air	MS	10AIRB	Agilent Technologies	5973 inert	GC/MS	TO-15
Air	GC	10AIRB	Agilent Technologies	6890	GC/MS	TO-15
Air	Concentrator	10AIRB	Entech Concentrator	7100A	GC/MS	TO-15
Air	GC	10AIRD	Agilent Technologies	7890A	GC/MS	TO14/15
Air	MS	10AIRD	Agilent Technologies	5975C	GC/MS	TO14/15
Air	Concentrator	10AIRD	Entech Instruments, Inc.	7100A	GC/MS	TO14/15
Air	Autosampler	10AIRE	Agilent Technologies	7693	GC/MS	TO17
Air	MS	10AIRE	Agilent Technologes	5975C	GC/MS	TO17
Air	GC	10AIRE	Agilent Technologies	7890A	GC/MS	TO17
Air	Thermal Desorber	10AIRE	Perkin Elmer	Turbomatrix 650	GC/MS	TO17
Air	Canister Autosampler	AIR7T1	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIR7T2	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIR8T1	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIR8T2	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIR0T1	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIR0T3	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIRD	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Canister Autosampler	AIRD	Entech Instruments, Inc.	7016 CA	NA	TO-15
Air	Can Cleaning Rack	Rack 1	Pace	na	NA	NA
Air	Can Cleaning Rack	Rack 2	Pace	na	NA	NA
Air	Can Cleaning Rack	Rack 3	Pace	na	NA	NA
Air	Pirani and Diaphragm Gauge	10AIR12	Vacuum Research Corp	902034	NA	NA
Air	Pirani and Diaphragm Gauge	10AIR13	Vacuum Research Corp	902034	NA	NA
Air	Pirani and Diaphragm Gauge	10AIR11	Vacuum Research Corp	902034	NA	NA
Air	Mass Flow Controller	10AIR14	Dwyer	GFM-1101	NA	NA
Air	Mass Flow Controller	10AIR15	Dwyer	GFM-1103	NA	NA
Air	Mass Flow Controller	10AIR16	Dwyer	GFM-2105	NA	NA
Air	Oven	10AIR10	Despatch	LDB Series	NA	General - Air
Air	Pressure Gauge	763	DH PPC3 100 PSI Auto	PGT-45L-30V/30	NA	NA
Air	Pressure Gauge	10AIR17	Omega Engineering	n/a	NA	NA

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Air	Mass Flow Controller	10AIR18	Dwyer	GFM-1103	NA	NA
HRMS	GC/MS	10MSHR09	Agilent	6890N	GC/MS	1613/8290/Mthd 23,29/TO9/DW
HRMS	GC/MS	10MSHR09	Waters/Micromass	Autospec Premier	GC/MS	1613/8290/Mthd 23,29/PCB
HRMS	GC/MS	10MSHR06	Agilent	6890A	GC/MS	1613/8290/Mthd 23,29/1614
HRMS	GC/MS	10MSHR06	Waters/Micromass	Autospec Ultima	GC/MS	1613/8290/Mthd 23,29
HRMS	GC/MS	10MSHR10	Thermo Scientific	Trace GC Ultra	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR10	Thermo Scientific	Trace GC Ultra	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR10	Thermo Scientific	DFS High Resolution Magnetic Sector MS	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR11	Thermo Scientific	Trace GC Ultra	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR11	Thermo Scientific	Trace GC Ultra	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR11	Thermo Scientific	DFS High Resolution Magnetic Sector MS	GC/MS	1613/8290/Mthd 23,29/DW
HRMS	GC/MS	10MSHR05	Agilent	6890A	GC/MS	1613/8290/Mthd 23,29/DW/PCB
HRMS	GC/MS	10MSHR05	Waters/Micromass	Autospec Ultima	GC/MS	1613/8290/Mthd 23,29
Dioxin DW	Balance	24254304	Denver Inst	MXX-5001	NA	General - DRMS Prep
Dioxin Prep	Balance	P1885308	A&D	EK4100i	NA	General - DRMS Prep
Dioxin Prep	Micro 100 Turbidimeter	10HR10	Scientific Inc.	Micro 100 Turbidimeter	NA	Turbidity
Dioxin Prep	Microwave	10HR11	CEM	MarsXpress	NA	8290/1613 Solid & Wipes, 1668A short list & 209 solids
Dioxin Prep	N-EVAP	N-EVAP 1	Organomation	112	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	N-EVAP 2	Organomation	112	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	N-EVAP 3	Organomation	112	NA	General - HRMS Prep
Dioxin Prep	Accelerated Solvent Extractor	10HR12	ACE	200	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	DW1	Organomation	8125	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	DW2	Organomation	8125	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	N-EVAP 4	Organomation	8125	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	N-EVAP 5	Organomation	8125	NA	General - HRMS Prep
Dioxin Prep	N-EVAP	N-EVAP 6	Organomation	8125	NA	General - HRMS Prep
Dioxin Prep	Media Baking Oven	DP4	Lindberg Blue	GO1340A-1	NA	General - HRMS Prep
Dioxin Prep	Med Level Muffle Furnace	DP5	Thermo	F6018	NA	General - HRMS Prep

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Dioxin Prep	Low Level Muffle Furnace	DP6	Thermo	F6018	NA	General - HRMS Prep
Metals	Balance	50206779	Sartorius	BP 110 S	NA	General - Metals
Metals	Balance	15612325	A&D	FX1200i	NA	General - Metals
Metals	Balance	P1884536	A&D	EK410i	NA	General - Metals
Metals	ICPMS	10ICM2	Perkin Elmer Sciex	Elan 9000	MS	Metals
Metals	ICPMS	10ICM3	Thermo Scientific	Xseries 2	MS	Metals
Metals	ICPMS	10ICM4	Thermo Scientific	XII	MS	Metals
Metals	ICPMS	10ICM5	Thermo Scientific	XII	MS	Metals
Metals	ICPMS	10ICM6	ICAP Q	na	MS	Metals
Metals	ICPMS	10ICM6	Cetac	AX-520	MS	Metals
Metals	ICPMS	10ICM6	Thermo Fisher	na	MS	Metals
Metals	ICPMS	10ICM6	Power Conditioner		MS	Metals
Metals	ICP	10ICP3	Perkin Elmer Instruments	Optima 4300 DV	SCCD	Metals
Metals	ICP	10ICP2	Perkin Elmer Instruments	Optima 4300 DV	SCCD	Metals
Metals	Tumbler	10MET06	Associated Design & Mfg. Co.	3740-24BRE	NA	TCLP Prep
Metals	Hot Block	10MET01	Environmental Express	na	NA	6010/Mercury/6020/200.8/Mthd 29
Metals	Hot Block	10MET02	Environmental Express	SC154	NA	6010/Mercury/6020/200.8/Mthd 29
Metals	Hot Block	10MET03	Environmental Express	na	NA	6010/Mercury/6020/200.8/Mthd 29
Metals	Hot Block	10MET04	Environmental Express	na	NA	6010/Mercury/6020/200.8/Mthd 29
Metals	Hot Block	10MET05	Thomas Cain Inc.	Deena 60	NA	Metals Prep
Metals	Hot Block	10MET08	Environmental Express	NA	NA	Metals Prep
Metals	Hot Block	10MET09	Environmental Express	NA	NA	Metals Prep
Metals	Hot Block	10MET10	Environmental Express	NA	NA	Metals Prep
Metals	Sonicator	10MET07	Fisher Scientific	FS20D	NA	Cleaning glassware
Metals	Mercury Analyzer	10HG3	Cetac Quick Trace	M-7500	NA	Mercury
Metals	Mercury Autosampler	10HG3	ASX-520	MAS Ver w/Diluter	NA	Mercury
Metals	Mercury Analyzer	10HG4	Cetac	M7600	NA	Mercury
Metals	Tumbler	10MET20	Environmental Express	na	NA	Metals Prep
Metals	Tumbler	10MET21	Associated Design & Mfg. Co.	3740-8-BRE	NA	Metals Prep
O-Prep	Balance	8200351	A&D	FX-2000	NA	General - O-prep
O-Prep	Balance	25455076	Denver Inst	MXX-612	NA	General - O-prep
O-Prep	UltraSonicator	10OP17	Branson	8S10	NA	General - O-prep
O-Prep	Sonicator	10OP01	Misonix	XL 2020	NA	3550
O-Prep	Sonicator	10OP02	Misonix	XL 2015	NA	3550
O-Prep	Sonicator	10OP03	Misonix	Sonicator 3000	NA	3550
O-Prep	Sonicator	10OP04	Misonix	Sonicator 3000	NA	3550
O-Prep	Soxtherm	10OP06	Gerhardt	na	NA	8082
O-Prep	Soxtherm	10OP07	Gerhardt	na	NA	8082
O-Prep	Soxtherm	10OP08	Gerhardt	na	NA	8082
O-Prep	Soxtherm	10OP09	Gerhardt	na	NA	8082
O-Prep	N-EVAP	10OP10	Organomation	112	NA	General - O-prep

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
O-Prep	N-EVAP	10OP11	Organomation	112	NA	General - O-prep
O-Prep	Centrifuge	10OP13	IEC	Centra GP8	NA	General - O-prep
O-Prep	Centrifuge	10OP14	Damon/IEC Division	na	NA	General - O-prep
O-Prep	Centrifuge	10OP15	International Clinical Centrifuge	CL28899M	NA	General - O-prep
SVOA	Balance	H47315	Mettler	AE 200	NA	General - SVOA
SVOA	GCMS	10MSSA	Agilent	7890A	MS	TO13, CPAH
SVOA	GCMS	10MSSA	Agilent/HP	7693 Series	MS	TO13, CPAH
SVOA	GCMS	10MSSA	Agilent/HP	7693 Series	MS	TO13, CPAH
SVOA	GCMS	10MSSA	Agilent/HP	5975C	MS	TO13, CPAH
SVOA	GCMS	10MSSA	Gersel	CIS 4	MS	TO13, CPAH
SVOA	GCMS	10MSSB	Agilent	7863B	MS	SIM, TO13, High Volume Injection
SVOA	GCMS	10MSSB	Agilent	7890	MS	SIM, TO13, High Volume Injection
SVOA	GCMS	10MSSB	Agilent	5975C	MS	SIM, TO13, High Volume Injection
SVOA	GCMS	10MSSB	Agilent	7863	MS	SIM, TO13, High Volume Injection
SVOA	GCMS	10MSSB	Gersel	CIS 4	MS	SIM, TO13, High Volume Injection
SVOA	GCMS	10MSSD	Agilent	6890N	MS	8270, PCP SIM
SVOA	GCMS	10MSSD	Agilent	5975	MS	8270, PCP SIM
SVOA	GCMS	10MSSD	Agilent	G2614A	MS	8270, PCP SIM
SVOA	GCMS	10MSSD	Agilent	G2915A	MS	8270, PCP SIM
SVOA	MS	10MSS3	HP	5973	MS	CPAH, PCP
SVOA	MS	10MSS3	HP	6890	MS	CPAH, PCP
SVOA	MS	10MSS3	Agilent/HP	7683	MS	CPAH, PCP
SVOA	MS	10MSS3	Agilent/HP	7683	MS	CPAH, PCP
SVOA	MS	10MSS3	Agilent/HP	7683	MS	CPAH, PCP
SVOA	MS	10MSS6	Agilent/HP	6890N	MS	SIM, PCP
SVOA	MS	10MSS6	Agilent/HP	7683	MS	SIM, PCP
SVOA	MS	10MSS6	Agilent/HP	5973N	MS	SIM, PCP
SVOA	MS	10MSS6	Agilent/HP	7683	MS	SIM, PCP
SVOA	MS	10MSS7	Agilent	6890	MS	8280
SVOA	MS	10MSS7	Agilent	G2613A	MS	8280
SVOA	MS	10MSS7	Hewlet Packard	G2614A	MS	8280
SVOA	MS	10MSS7	Agilent	G2579A	MS	8280
SVOA	MS	10MSS8	Agilent	7683	MS	Sulfolane, 8270, 625
SVOA	MS	10MSS8	Agilent	6890N	MS	Sulfolane, 8270, 625
SVOA	MS	10MSS8	Agilent	5973N	MS	Sulfolane, 8270, 625
SVOA	MS	10MSS8	Agilent	7683	MS	Sulfolane, 8270, 625
SVOA	MS	10MSS9	Agilent	6890A	MS	8270, 625
SVOA	MS	10MSS9	Agilent	18593B	MS	8270, 625
SVOA	MS	10MSS9	Agilent	5973N	MS	8270, 625
SVOA	MS	10MSS9	Agilent	18596C	MS	8270, 625
SVOA	GC	10GCSA	Agilent	6890N	Dual FID	8082, 8081
SVOA	GC	10GCSA	Agilent	G2614A	Dual FID	8082, 8081
SVOA	GC	10GCSB	Agilent	G4513A	Dual FID	8082, 8081
SVOA	GC	10GCSB	Agilent	G4514A	Dual FID	8082, 8081
SVOA	GC	10GCSB	Agilent	7890A	Dual FID	8082, 8081

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
SVOA	GC	10GCS4	HP	5890	Dual FID	AK, NWTPH
SVOA	GC	10GCS4	HP	7673A	Dual FID	AK, NWTPH
SVOA	GC	10GCS4	HP	7673A	Dual FID	AK, NWTPH
SVOA	GC	10GCS5	HP	5890 SII	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS5	HP	18596B	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS5	HP	7673	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS7	Agilent	6890N	Dual ECD	PCB, TO4
SVOA	GC	10GCS7	Agilent	G2614A	Dual ECD	PCB, TO4
SVOA	GC	10GCS7	HP	N279	Dual ECD	PCB, TO4
SVOA	GC	10GCS8	Agilent	6890N	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS8	Agilent	7683	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS8	Agilent	7683	Dual FID	CALDRO, WIDRO
SVOA	GC	10GCS9	Agilent	7890	Dual FID	DRO
SVOA	GC	10GCS9	Agilent	G4513A	Dual FID	DRO
SVOA	GC	10GCS9	Agilent	G4514A	Dual FID	DRO
SVOA	GC	10GCSC	Agilent	6890 N	Dual FID	NwTPH, WIDRO
SVOA	GC	10GCSC	Agilent	G2614A	Dual FID	NwTPH, WIDRO
SVOA	GC	10GCSC	Agilent	G2614A	Dual FID	NwTPH, WIDRO
SVOA	Oven	10WET49	Fisher Scientific	NA	NA	% Moisture
SVOA	Oven	10WET50	Baxter DS-64	DS-64	NA	% Moisture
VOA	Balance	21353507	Denver Inst	MXX-212	NA	General - VOA
VOA	Balance	5304905	A&D	FX-3200	NA	General - VOA
VOA	Balance	P1897220	A&D	EK-300i	NA	General - VOA
VOA	AutoSampler	10MSV1	Environmental Sample Tech, Inc.	na	NA	UST, BTEX
VOA	Concentrator	10MSV1	Tekmar	3000	GC/MS	UST, BTEX
VOA	GC System	10MSV1	HP	6890	GC/MS	UST, BTEX
VOA	MS Detector	10MSV1	HP	5973	GC/MS	UST, BTEX
VOA	GC System	10MSV3	Agilent	6890	GC/MS	8260 Med. Lvl Soil
VOA	AutoSampler	10MSV3	EST Analytical	Centurion	MS	8260 Med. Lvl Soil
VOA	Concentrator	10MSV3	Encon Evolution	na	GC/MS	8260 Med. Lvl Soil
VOA	MS Detector	10MSV3	Agilent	5973	GC/MS	8260 Med. Lvl Soil
VOA	AutoSampler	10MSV5	EST Analytical	Centurion	NA	8260/624/TCLP/UST
VOA	Concentrator	10MSV5	Encon Evolution	na	GC/MS	8260/624/TCLP/UST
VOA	GC System	10MSV5	HP	6890	GC/MS	8260/624/TCLP/UST
VOA	MS Detector	10MSV5	HP MS	5973	GC/MS	8260/624/TCLP/UST
VOA	AutoSampler	10MSV6	Varian Archon	na	NA	524/8260/624
VOA	Concentrator	10MSV6	Tekmar	3000	GC/MS	524/8260/624
VOA	GC System	10MSV6	Agilent	6890A	GC/MS	524/8260/624
VOA	MS Detector	10MSV6	Agilent	5973	GC/MS	524/8260/624
VOA	AutoSampler	10MSV7	Environmental Sample Tech, Inc.	na	NA	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	GC System	10MSV7	Agilent Technologies	6850	GC/MS	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	Concentrator	10MSV7	Tekmar	3000	GC/MS	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	MS Detector	10MSV7	Agilent Technologies	5975C	GC/MS	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
VOA	GC System	10MSV8	5975C	5975C	GC/MS	8260/624/TCLP/UST
VOA	AutoSampler	10MSV8	EST Analytical	Centurion	NA	8260/624/TCLP/UST
VOA	Concentrator	10MSV8	Encon Evolution	na	GC/MS	8260/624/TCLP/UST
VOA	MS Detector	10MSV8	Agilent	5975C	GC/MS	8260/624/TCLP/UST
VOA	AutoSampler	10GCV1	Environmental Sample Tech, Inc.	na	NA	8021/8015/GRO
VOA	Concentrator	10GCV1	Tekmar Dohrmann	3100	NA	8021/8015/GRO
VOA	GC System	10GCV1	HP	5890	PID/FID	8021/8015/GRO
VOA	AutoSampler	10GCV3	EST Analytical	Centurion	NA	8021/8015/GRO
VOA	Concentrator	10GCV3	Tekmar Dohrmann	3000	NA	8021/8015/GRO
VOA	GC system	10GCV3	HP	5890 Series II	PID/FID	8021/8015/GRO
VOA	AutoSampler	10GCV5	Environmental Sample Tech, Inc.	na	NA	8021/8015/GRO
VOA	Concentrator	10GCV5	Tekmar	3100	NA	8021/8015/GRO
VOA	GC system	10GCV5	HP	G1530A	PID/FID	8021/8015/GRO
VOA	AutoSampler	10GCV6	EST Analytical	Archon 8100	NA	8021/8015/GRO
VOA	Concentrator	10GCV6	Tekmar	14-3100-EOL	NA	8021/8015/GRO
VOA	GC system	10GCV6	Agilent/HP	HP 6890	PID/FID	8021/8015/GRO
VOA	Oven	10VOA03	Thermo Scientific	na	NA	General - VOA
VOA	Sonicator	10VOA04	Fisher Scientific	FS220	NA	8260/8021/8015/GRO
Wet Chem	Balance	10406293	Sartorius	AC 210 S	NA	General - Wet Chem
Wet Chem	Balance	7123180939	Ohaus	Scout Pro	NA	General - Wet Chem
Wet Chem	Balance	30208225	Sartorius	AC 210 S	NA	General - Wet Chem
Wet Chem	Balance	1125521193	Mettler-Toledo	AB135-S	NA	General - Wet Chem
Wet Chem	Balance	13407030	Sartorius	LA3200D	NA	General - Wet Chem
Wet Chem	Incubator	10WET16	Fisher Scientific	Isotemp Incubator	NA	BOD
Wet Chem	Incubator	10WET22	Fisher Scientific	307	NA	BOD
Wet Chem	Incubator	10WET35	Fisher Scientific	307C	NA	BOD
Wet Chem	Incubator	10WET60	Thermo Forma	3940	NA	BOD
Wet Chem	Autotitrator	10WET6	Metrohm	888 Titrando Titrator	NA	Alkalinity
Wet Chem	Autosampler	10WET6	Metrohm	778 Sample Processor	NA	Alkalinity
Wet Chem	Diss. Oxy Meter	10WET51	YSI	5000	NA	BOD
Wet Chem	Oven	10WET17	Precision Scientific	130 DM	NA	General - Wet Chem
Wet Chem	Oven	10WET20	Fisher Scientific	Isotemp Oven	NA	General - Wet Chem
Wet Chem	AutoClave	10WET29	Harvey	na	NA	General - Wet Chem
Wet Chem	pH Meter	10WET7	Orion	na	NA	pH
Wet Chem	pH Meter	10WET31	IQ Scientific Instruments	na	NA	pH
Wet Chem	Thermoreactor	10WET26	Neutec Group Inc.	ECO 25	NA	COD
Wet Chem	COD Reactor	10WET11	Bioscience, Inc.	na	NA	COD
Wet Chem	KoneLab	10WET3	Thermo Fisher Scientific	Konelab 20	NA	Colormetric
Wet Chem	Conductivity meter	10WET9	Oaktom	Con 110 Series	NA	Specific Conductivity
Wet Chem	Colony Counter	10WET30	Gallenkamp	Colony Counter	NA	HPC

ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Wet Chem	Colony Counter	10WET38	Darkfield Quebec	Colony Counter	NA	HPC
Wet Chem	Water Bath	10WET27	Fisher Scientific	Isotemp 210	NA	General - Wet Chem
Wet Chem	Digestion Block	10WET12	Environmental Express	na	NA	SM4500-P-E
Wet Chem	Digestion Block	10WET13	MIDI-STIL	na	NA	SM4500-P-E
Wet Chem	Spectrometer	10WETA	Hach	DR 2700	NA	COD
Wet Chem	Hot Plate	10WET34	Presto	Tilt'n Drain Big Griddle	NA	General - Wet Chem
Wet Chem	Smart Chem	10WT36	West Co Scientific Instruments	Smart Chem 200	NA	Colormetric
Wet Chem	Hot Plate	10WET40	Corning	na	NA	General - Wet Chem
Wet Chem	Stir Plate	10WET41	Fisher Scientific	na	NA	General - Wet Chem
Wet Chem	Stir Plate	10WET42	Barnstead/Thermolyne	S46725/Cimarec 2	NA	General - Wet Chem
Wet Chem	Stir Plate	10WET43	Fisher Scientific	na	NA	General - Wet Chem
Wet Chem	Vortex Mixer	10WET44	American Scientific Prod.	S8223-1	NA	General - Wet Chem
Wet Chem	Extractor	10WET45	Horizon Technology	Spe-dex 4790	NA	Oil & Grease
Wet Chem	Extractor	10WET46	Horizon Technology	Spe-dex 4791	NA	Oil & Grease
Wet Chem	Extractor	10WET47	Horizon Technology	Spe-dex 4792	NA	Oil & Grease
Wet Chem	Extractor	10WET48	Horizon Technology	Spe-dex 4793	NA	Oil & Grease
Wet Chem	Closed Cup - Pensky	10WT49	Precision Scientific	na	NA	Flashpoint
Wet Chem	IC - autosampler	10WT52	Dionex	AS50	NA	Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0
Wet Chem	IC - oven	10WT52	Dionex	LC25	NA	Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0
Wet Chem	IC - conductivity detector	10WT52	Dionex	CD20	NA	Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0
Wet Chem	IC - gradient pump	10WT52	Dionex	GP50	NA	Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0
Wet Chem	ph/BOD meter	10WT54	Hach	LBOD10101	NA	BOD
Wet Chem	ph/BOD meter	10WT53	Hach	HQ40d	NA	BOD
Wet Chem	Hot Block	10WET55	Environmental Express	na	NA	COD
Wet Chem	Oven	10WT56	Lindberg/Blue M	MO1450PSA-1	NA	General - Wet Chem
Wet Chem	Oven	10WET65	Fisher Scientific	13-247-650G(6905)	NA	General - Wet Chem
Wet Chem	pH Probe	11662571034	Hach	PHC301	NA	pH
Wet Chem	pH Probe	121952571033	Hach	PHC301	NA	pH
Wet Chem	pH Probe	122143032067	Hach	LBOD101	NA	pH
Wet Chem	pH Probe	712202002	Switchcraft	PHW77-SS	NA	pH
Wet Chem	Turbidity Meter	10WT59	Hach	2100Q	NA	Turbidity
Wet Chem	Hand Held Brix Refractometer	10WT60	Fisher	na	NA	
Wet Chem	Oven	10WET19	VWR Scientific	1370F	NA	General - Wet Chem

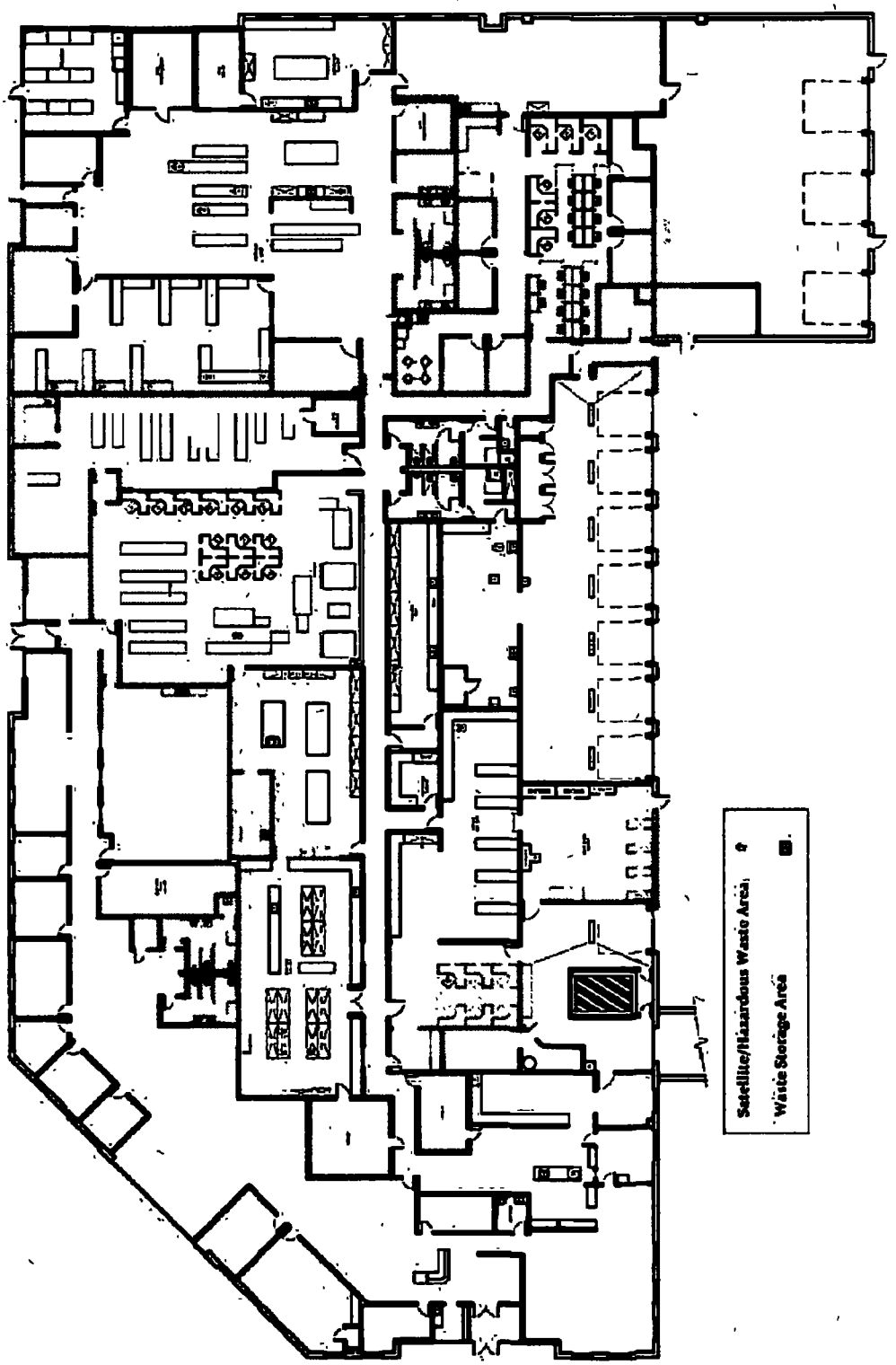
ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Wet Chem	Ion Analyzer	10WET15	Orion	na	NA	
Wet Chem	Quanti-Tray Sealer Model 2x	10WET56	Quanti-Tray	89-10894-02	NA	SM9223B
Wet Chem	IC	10WT61	Metrohm	881 Compact IC	NA	Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0
Wet Chem	Lachat	10WT62	Quick Chem	8500	NA	SM4500Cl-E, SM4500P-E, SM3500CrB, EPA 420.4
Wet Chem	Auto Titrator	10WT63	Metromn	814 USB Sample Processor	NA	
Wet Chem	Fluoride Probe	10WET64	Hanna Instruments	HI 98402	NA	Fluoride
Wet Chem	JT Backer Speedisk Expanded Extration Station	10WET66	J.T. Baker	Speedisk Expanded Extraction Station	NA	
Wet Chem	COD/Cyanide Block (dual reactor, two heat blocks)	10WET67	Hach	DRB 200	NA	COD
Montana	Balance	24353410	Denver	MXX-212	NA	General
Montana	Balance	14138	Fisher	7227DA	NA	General
Montana	Balance	40020019	Sartorius	LC620S	NA	General
Montana	Balance	B027060	Fisher	A200DS	NA	General
Montana	Balance	G3251202300491	Ohaus	ARC120	NA	General
Montana	Balance	E86392	Mettler	AE100	NA	General
Montana	Microscope	11MT28	Olympus	BH-2	NA	Asbestos
Montana	Microscope	11MT29	Olympus	BH-2	NA	Asbestos
Montana	Microscope	11MT32	Olympus	BH-2	NA	Asbestos
Montana	Muffle Furnace.	11MT12	Sybron	Thermolyne	NA	General
Montana	Oven	11MT10	Fisher	Isotemp 255D	NA	General
Montana	Oven	11MT11	Fisher	Isotemp 630F	NA	General
Montana	Oven	11MT35	Precison	NA	NA	General
Montana	Oven	11MT41	Fisher	Isotemp 630F	NA	General
Montana	Oven	11MT42	Precison	Thelco 130 DM	NA	General
Montana	SVOA GC	11MT03	Hewlett-Packard	5890A	FID/PID	EPH
Montana	Autosampler	11MT03	Hewlett-Packard	7673	NA	EPH
Montana	Autosampler	11MT03	Hewlett-Packard	7673	NA	EPH
Montana	Autosampler	11MT04	Hewlett-Packard	7673	NA	EPH
Montana	Autosampler	11MT04	Hewlett-Packard	7673	NA	EPH
Montana	SVOA GC	11MT04	Hewlett-Packard	5890	FID/PID	EPH
Montana	IC Autosampler	11MT05	Dionex	AS40-1	NA	EPA Method 300.0
Montana	Ion Chromatograph	11MT05	Dionex	ICS1000	NA	EPA Method 300.0
Montana	Autoanalyzer Autosampler	11MT06	Astoria Pacific	311	NA	N+N, NH3, TKN
Montana	Autoanalyzer Detector	11MT06	Astoria Pacific	305A	Wavelength	N+N, NH3, TKN
Montana	Autoanalyzer Heater Unit	11MT06	Astoria Pacific	303A	NA	N+N, NH3, TKN
Montana	Autoanalyzer Photometer	11MT06	Astoria Pacific	350	NA	N+N, NH3, TKN
Montana	Autoanalyzer Power Supply	11MT06	Astoria Pacific	304A	NA	N+N, NH3, TKN
Montana	Autosampler power supply	11MT06	Perstorp	509	NA	N+N, NH3, TKN
Montana	Autosampler pump	11MT06	Perstorp	502	NA	N+N, NH3, TKN
Montana	Spectrophotometer	11MT08	Spectronic	Aquamate	NA	Cr VI, N02, Tphos, Ophos

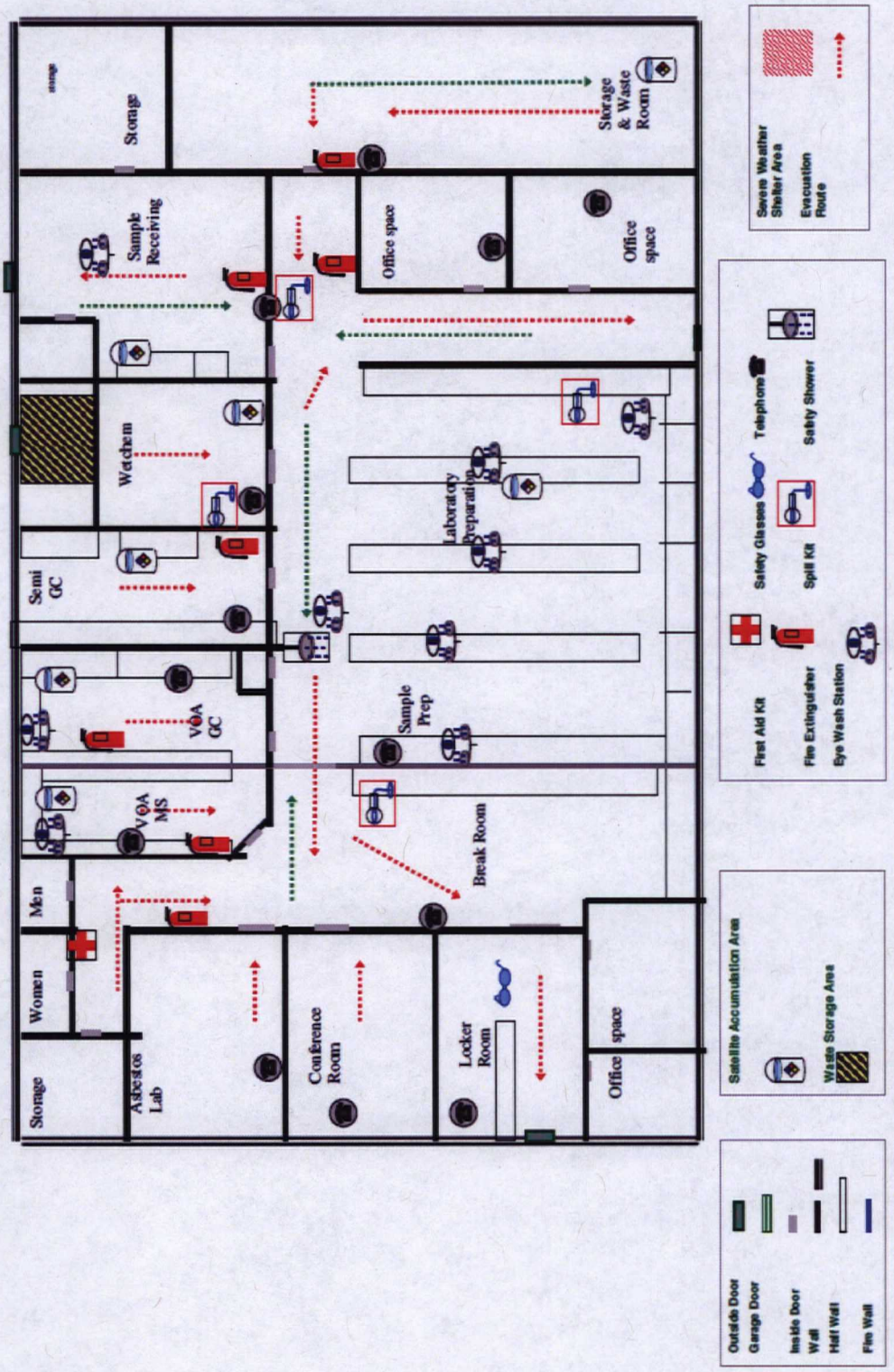
ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE) CONTINUED

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	DETECTOR(S)	ANALYSIS
Montana	Concentrator	11MT13	Zymark	TurboVap II	NA	Oprep
Montana	Concentrator	11MT14	Zymark	TurboVap II	NA	Oprep
Montana	Furnace	11MT15	Sybron Thermolyne	1300	NA	General
Montana	Waterbath	11MT17	Northwest Fixtures	I5505	NA	General
Montana	pH meter	11MT18	Fisher	AR50	NA	pH
Montana	Sonicator	11MT19	Fischer	FS60	NA	General
Montana	Centrifuge	11MT20	Fischer	Centific	NA	General
Montana	Furnace	11MT22	Leco	S-144DR	NA	General
Montana	Turbidimeter	11MT23	HF Scientific	Micro 1000	NA	Turbidity
Montana	Sonicator	11MT24	Heat Systems	Sonicator XL	NA	General
Montana	Sonicator	11MT25	Branson	Sonfier 450	NA	General
Montana	Stereoscope	11MT30	Fisher	8711	NA	Asbestos
Montana	Stereoscope	11MT31	Olympus	G10X	NA	Asbestos
Montana	Concentrator	11MT33	Tekmar/Dohrmann	Tekmar 3000 Purge and Trap Conc.	FID/PID	VPH
Montana	VOA GC	11MT33	Agilent	6890	FID/PID	VPH
Montana	Autosampler	11MT33	EST	Centurion	NA	VPH
Montana	Block Digestor	11MT34	Lachat	BD-46	NA	TKN
Montana	AutoSampler	11MT38	O-I-Analytical	4552	NA	8260
Montana	Concentrator	11MT38	Tekmar Dohrmann	3100	NA	8260
Montana	GC System	11MT38	Agilent	6890	GC	8260
Montana	MS Detector	11MT38	Agilent	5973	MS	8260
Montana	Thermoreactor	11MT39	Velp Scientifica	F101A0125	NA	350.1
Montana	pH meter	11MT40	Accumet	AR50	NA	pH
Montana	GC System	11MT43	Agilent	6890	FID/PID	VPH, 8015/GRO, 8021
Montana	Concentrator	11MT43	EST	Evolution	FID/PID	VPH, 8015/GRO, 8021
Montana	AutoSampler	11MT43	EST	Centurion	FID/PID	VPH, 8015/GRO, 8021
Montana	Flow Analyzer	11MT44	Lachat	8500	NA	350.1, 353.2, 351.2
Montana	Concentrator	11MT51	Zymark	Turbo Vap II	NA	Oprep

ATTACHMENT IVA- MINNEAPOLIS LABORATORY FLOOR PLAN (CURRENT AS OF ISSUE DATE)



ATTACHMENT IVB- MONTANA LABORATORY FLOOR PLAN (CURRENT AS OF ISSUE DATE)



ATTACHMENT V- LABORATORY SOP LIST (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Determination of Methane, Ethane, and Ethene in Air Modified TO-3	S-MN-A-002
Analysis of Air Samples for Volatile Organic Compounds by Gas Chromatography/PID-FID method TO-3	S-MN-A-003
Cleaning, Certification, Leak Checking and Preparation for Shipment of SUMMA Passivated Canisters	S-MN-A-004
Determination of Fixed Gases in Air by Modified 3C	S-MN-A-005
Methane, Ethane, Ethene, and Propane in Water by GCFID mod. 3810 and RSK 175	S-MN-A-007
Analysis of Whole Air Sample for Volatile Organic Compound by GC/MS EPA TO15/TO14	S-MN-A-013
Determination of Hydrocarbons in Air using Radiello Passive Sample Tubes	S-MN-A-017
Analysis of TO17 Active Air Samples	S-MN-A-018
Sample Management	S-MN-C-001
Bottle Preparation	S-MN-C-003
Subcontracting Samples	S-MN-C-004
Internal Chain of Custody	S-MN-C-005
Percent Solids (Moisture)	S-MN-I-367
Drierite Regeneration Procedure	S-MN-O-557
The Determination of Specific Aromatic Compounds and Gasoline Range Organic in Water and Soils	S-MN-O-427
Purgeable Total Petroleum Hydrocarbons in Water (8015 Mod / CA LUFT)	S-MN-O-525
Purgeable Total Petroleum Hydrocarbons in Water (NWTPH)	S-MN-O-555
Determination of Gasoline Range Organices by Method AK101	S-MN-O-556
Volatiles Sample Compositing Procedure	S-MN-O-541
Analysis of Volatile Petroleum Hydrocarbons (VPH)	S-MN-O-575
Analysis of Polychlorinated Biphenyls in Oil, Soil, Water, Wipe and Air Matrixes	S-MN-O-432
Determination of Diesel Range Organics in Water and Soil (Wisconsin modified DRO)	S-MN-O-466
Determination of Diesel Range Organics in Water & Soil SW8015 (Modified)	S-MN-O-489
Ethylene glycol, Propylene Glycol, Triethylene Glycol by Modified 8015	S-MN-O-533
The Determination of Extractable Petroleum Hydrocarbons by Method NWTPH-Dx	S-MN-O-553
The Determination of Diesel Range Organics and Residual Range Organics by AK102-AK103	S-MN-O-554
Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons	S-MN-O-567
Determination of Pesticides in Water and Soil	S-MN-O-574
Determination of EDB and DBCP in Aqueous Samples	S-MN-O-576
Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8290	S-MN-H-001
Preparation and Analysis of Samples for the Determination of Dioxins and Furans using USEPA Method 1613B	S-MN-H-002
Preparation and Analysis of Samples for the Determination of 2,3,7,8-TCDD using USEPA Method 1613B, Drinking Water	S-MN-H-003
Percent Lipids Determination	S-MN-H-004
Preparation and Analysis of Samples for the Determination of PCDDs, PCDFs, and PCBs by modified USEPA Method 23, TO9, or NY State Guidelines	S-MN-H-005
Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8280A	S-MN-H-007
Method 1668, PCB Congenger (WHO List)	S-MN-H-009
Preparation and Analysis of Samples for the Determination of Chlorinated Biphenyl Congeners by USEPA Method 1668A	S-MN-H-014
Preparation and Analysis of Samples for the Determination of Polybrominated Diphenyl Ether Congeners	S-MN-H-016
Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8290A	S-MN-H-019
Preparation and Analysis of Samples for the Determination of Dioxin and Furans by USEPA Method DLM2.0	S-MN-H-021
Preparation and Analysis of Samples for the Determination of Chlorinated Biphenyl Congeners	S-MN-H-022
Operation and Maintenance of the Perkin Elmer ELAN 9000 ICP-MS	S-MN-I-525
TCLP/SPLP	S-MN-I-312
Inductively Coupled Plasma Atomic Emission Spectroscopy (RCRA)	S-MN-I-313
Hardness by Calculation	S-MN-I-338
Mercury im Liquid and Solid/Semis-Solid Waste	S-MN-I-359
Digest Procedure for Aqueous Samples to be Analyzed by Induct Coupled Plasma (SW-846)	S-MN-I-458
Metals Preparation for Solid samples, Wipes and Filters	S-MN-I-460
Metals Analysis by ICP/MS - Method 6020 and 200.8	S-MN-I-492
Preparation of Aqueous Samples for ICPMS Analysis by Method 3030C	S-MN-I-523
Operation of the DEENA automated Prep System	S-MN-I-531
Mercury in Solid Waste by CLP	S-MN-I-557
Extractable Base/Neutral and Acid Organic Compounds in Liquid, Solid, and TCLP Matrices by Gas Chromatography/Mass Spectrometry Capillary Column Technique	S-MN-O-436

ATTACHMENT V- LABORATORY SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Title	SOP Number
8270-L Extractable Base/Neutral and Acid Organic Compounds in Water and Liquid Matrices by GC/MS Capillary Column Technique w/Selective Ion Monitoring	S-MN-O-507
Extractable Base/Neutral and Acid Organic Compounds in Liquid by EPA Method 625	S-MN-O-532
Determination of Parent and Alkylated PAH Compounds in Solid and Liquid Matrices by GC/MS SIM	S-MN-O-561
Analysis of Air samples by GC/MS - Method TO-13	S-MN-O-534
Qualitative ID of Biomarkers by SIM	S-MN-O-568
Sulfolane Extraction and Analysis in Liquid Matrices by GCMS	S-MN-O-569
High Volume Injection for 8270C SIM	S-MN-O-570
Sulfolane Extraction and Analysis in Solid Matrices by GC/MS: Capillary Column Technique	S-MN-O-572
Analysis of Volatile Organic Compounds by GC/MS Method 8260	S-MN-O-521
Analysis of Volatile Organic Compounds by GC/MS Method 624	S-MN-O-529
Analysis of Volatile Organic Compounds in Water Method 524.2	S-MN-O-546
Analysis of 1,4 Dioxane by Selective Ion Monitoring (SIM) GC/MS SW846 Method 8260B Modified	S-MN-O-558
Determination of Vinyl Chloride by SIM 8260	S-MN-O-577
Method For Sonicator Tuning	S-MN-O-414
Cleaning Glassware in the Organic Laboratory	S-MN-O-465
Sonication Extraction Technique (SW3550) for Base/Neutral and Acid Compounds	S-MN-O-495
Continuous Liquid-Liquid Extraction (SW3520) for Base/Neutral and Acid Compounds	S-MN-O-496
Spike Verification in the Organic Prep Lab	S-MN-O-497
Preparation of Anhydrous Sodium Sulfate for Extraction Purposes	S-MN-O-500
Nitrogen Evaporation Technique	S-MN-O-503
Sample Concentration Technique	S-MN-O-504
Separatory Funnel Extraction for Polyaromatic Hydrocarbons by 8270-SIM	S-MN-O-506
Solvent Exchange into Hexane	S-MN-O-509
Continuous Liq/Liq extraction for Method 8270C (Dual pH) by SW 3520C	S-MN-O-539
Soxhlet Extraction for PAH Analysis by GC/MS:SIM	S-MN-O-540
Separatory Funnel Extraction	S-MN-O-566
Data Archiving	S-MN-L-106
Reagent Water Quality	S-MN-L-110
Generation of EDD	S-MN-L-112
Preventative, routine, and non-routine maintenance	S-MN-L-114
Receipt and Storage of Laboratory Supplies	S-MN-L-117
Data Reduction, Validation, and Reporting in the Env Lab	S-MN-L-132
Syringe Technique	S-MN-L-139
Procedure for Handling Aqueous Organic Extractable Samples Containing Sediment	S-MN-L-142
Purchasing Laboratory Supplies	S-MN-L-143
Sample Homogenization and Sub-Sampling	S-MN-L-147
Quality Manual	Quality Manual
Control Chart Generation and Trend Analysis	S-MN-Q-205
Manual Integration	S-MN-Q-214
Control of Hazardous Energy Program - Lockout/Tagout	S-MN-Q-249
Method Validation and Modification Studies	S-MN-Q-252
Procedure for Handling of USDA regulated soils	S-MN-Q-253
Estimation of Measurement Uncertainty	S-MN-Q-255
Management of Change	S-MN-Q-257
Proficiency Testing Program	S-MN-Q-258
Evaluation and Qualification of Vendors	S-MN-Q-259
Use of A2LA Terms and Symbols	S-MN-Q-260
Conflict of Interest Plan	S-MN-Q-261
Corrective and Preventative Actions	S-MN-Q-262
Monitoring Storage Units	S-MN-Q-263
Support Equipment	S-MN-Q-264
Document Control and Management	S-MN-Q-268
Determination of Limit of Detection and Limit of Quantitation	S-MN-Q-269
Review of Analytical Requests	S-MN-Q-270
Internal and External Audits	S-MN-Q-271
MCL Violation Reporting	S-MN-Q-272
Preparation of Standard Operating Procedures	S-MN-Q-273
Software Validation	S-MN-Q-274
Standard and Reagent Management and Traceability	S-MN-Q-275
Chemical Hygiene Plan/Safety Manual	S-MN-S-001
Waste Training Management Requirements	S-MN-S-002

ATTACHMENT V- LABORATORY SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Waste Handling and Management	S-MN-S-003
MN Contingency Plan	2012
Biochemical Oxygen Demand (BOD)	S-MN-I-348
Phenols	S-MN-I-354
Oil & Grease - 1664	S-MN-I-357
Hexavalent Chromiumin in Water, Wastewater, and Soil	S-MN-I-358
Alkalinity, Titrimetric	S-MN-I-365
Fluoride in Water and Wastewater	S-MN-I-470
Determination of Total and Ortho Phosphorus in Aqueous Samples by SmartChem	S-MN-I-473
Specific Conductivity	S-MN-I-474
Ortho Phosphorus	S-MN-I-477
Settleable Solids	S-MN-I-486
Standard Test Method for Screening Apparent Specific Gravity and Bulk Density Waste	S-MN-I-493
Determination of Total Recoverable Phenolics by Flow Injection Colorimetry	S-MN-I-494
Turbidity in Water	S-MN-I-501
Chlorine, Total Residual in Water	S-MN-I-502
Use and Maintenance of the Konelab	S-MN-I-507
Determination of Nitrate/Nitrite in surface/wastewaters by Flow Injection Analysis by SmartChem	S-MN-I-508
Determination of Chloride by Konelab	S-MN-I-509
Determination of Sulfate by Konelab	S-MN-I-510
Determination of Nitrite by Konelab(Spectrophotometric Method)	S-MN-I-514
Paint Filter Liquids Test	S-MN-I-516
Determination of Hexane Extractable material (HEM) and Silica Gel Treated – Hexane Extractable Material (SGT-HEM)	S-MN-I-520
Dissolved Oxygen	S-MN-I-524
Measurement of pH in Water, Soil, and Waste	S-MN-I-526
Determination of TSP and PM 10	S-MN-I-527
Measurement of Solids in Water and Wastewater	S-MN-I-528
Total CN in Water - Macro Distillation	S-MN-I-529
Weak Acid Dissociable Cyanide in Water - Macro Distillation	S-MN-I-530
Total Coliform Bacteria	S-MN-MB-001
Fecal Coliform by MF	S-MN-MB-002
Heterotrophic Plate Count	S-MN-MB-003
Total Coliform Bacteria by MF	S-MN-MB-005
Sample Container Sterility Verification	S-MN-MB-006
Total Coliform Bacteria and E. Coliform Bacteria	S-MN-MB-007
The Determination of Ammonia by SmartChem	S-MN-I-559
Determination of NO3/NO2 by SmartChem	S-MN-I-560
Cation - Anion Balance	S-MN-I-562
COD by Hach 2700	S-MN-I-563
Cyanide in Water by SmartChem	S-MN-I-564
Delta Airlines Anodizing Line	S-MN-I-582
Determination of Inorganic Anions by Ion Chromatography	S-MN-I-583
Determination of Nitrate/Nitrite on the Lachat by Cadmium Redution	S-MN-I-584
Determination of Sulfate on the Lachat	S-MN-I-585
Net Acid Generation (NAG)	S-MN-I-589
Humidity Cells	S-MN-I-590
Bottle Order Database	S-ALL-C-002
Operation of Paceport Customer Feedback Form	S-ALL-C-005
Document Numbering	S-ALL-Q-003
EPIC PRO: Acode Validation	S-ALL-Q-007
EPIC PRO: Acode Addition/Modification	S-ALL-Q-008
Laboratory Documentation	S-ALL-Q-009
Quarterly Quality Report	S-ALL-Q-014
Review of Laborartory Management System	S-ALL-Q-015
Training Procedures	S-ALL-Q-020
3P Program: CIP	S-ALL-Q-022
Use and Operation of Lab Track System	S-ALL-Q-028
Mint Miner Data File Review	S-ALL-Q-029
Operation of Data Checker For Epic Pro	S-ALL-Q-030
Data Recall	S-ALL-Q-035
Processing Tentatively Identified Compounds (TICS) for GC/MS	S-ALL-Q-038

ATTACHMENT V- LABORATORY SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Hazard Assessments	S-ALL-S-001
LMS Sub-Learn Center System and Training Administrator Responsibilities	S-ALL-T-002
Microscope Adjustment - Phase Contrast	S-MT-I-015
Microscope Alignment - Polarized Light Microscope	S-MT-I-016
Bulk Analysis Using Polarized Light Microscopy	S-MT-I-023
Asbestos Data Review	S-MT-I-026
Fiber Counts By NIOSH 7400 Using Excel Spreadsheet	S-MT-I-027
Quality Control for Asbestos Analysis	S-MT-I-028
Data Correctness Calculations	S-MN-I-562
Sample Homogenization and Sub-Sampling	S-All-Q-021
The Determination of Extractable Petroleum Hydrocarbons by Method MA-EPH	S-MT-O-001
Petroleum Hydrocarbons as Diesel in Water and Soil	S-MT-O-002
Purgeable Total Petroleum Hydrocarbons in Water and Soil	S-MT-O-003
Volatile Petroleum Hydrocarbons (VPH)	S-MT-O-005
Drierite Regeneration Procedure	S-MN-O-557
Spike Verification	S-MN-O-497
Cleaning Glassware in the Laboratory	S-MN-O-465
Volatiles Water Sample Composition Procedure	S-MN-O-541
Purgeable Total Petroleum Hydrocarbons in Water (8015 Mod / CA LUFT)	S-MN-O-525
Determination of Specific Aromatic Compounds & Gasoline Range Organics in Water and Soils	S-MN-O-427
Coarse Fragment	S-MN-I-552
Acid-Base Accounting - Sobek	S-MT-I-004
pH Paste	S-MT-I-006
Soil Sieve for Black Eagle	S-MT-I-017
Volatile Organic Compounds by 8260B	S-MT-O-004
Preparation of Anhydrous Sodium Sulfate for Extraction Purposes	S-MT-O-008
Reagent Water Quality	S-MN-L-110
MT Contingency plan	2012
Nitrite by SM4500 NO2B	S-MN-I-556
Acidity	S-MT-I-032
Turbidity	S-MN-I-572
Organic Matter	S-MT-I-001
Phosphorus, Ortho and Total	S-MT-I-002
Vegetative Fluoride	S-MT-I-003
Sulfides	S-MT-I-005
Specific Conductivity SW2510B	S-MT-I-007
Measurement of Solids in Water and Wastewater	S-MT-I-008
The Determination of Nitrate-Nitrite by Flow Analyzer	S-MT-I-009
TKN By Colorimetry	S-MT-I-010
Colormetric Hexavalent Chromium	S-MT-I-011
Total Sufur by LECO	S-MT-I-012
Water Soluble Sulfate and Chloride	S-MT-I-013
The Determination of Percent Moisture in Soil and Solid Samples	S-MT-I-014
Determination of Inorganic Anions by Ion Chromatography	S-MT-I-018
Determination of Ammonia Nitrogen by Automated Phenate	S-MT-I-019
Chlorophyll-a	S-MT-I-020
Measurement of pH in Water, Soil, and Waste	S-MT-I-021
Available Nitrate and Ammonia	S-MT-I-022
Particle Size Analysis	S-MT-I-024
Determination of Oxidation-Reduction Potential in Water	S-MT-I-029
Settleable Solids	S-MT-I-030
Determination of Dissolved Oxygen	S-MT-I-031

ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE) SCOPE AND APPLICATION CERTIFICATES ARE MAINTAINED AND FILED IN THE LOCAL QUALITY DEPARTMENT

EPA ID: MN00064				
State	Agency	Program	Cert #	Expiration
A2LA	A2LA	Dioxin, Environmental, Air; DOD	2926.01	10/31/2013
Alabama	Dept of Environmental Mgmt	Dioxin-DW	40770	12/31/2013
Alaska	Dept. of Environmental Conservation	Contaminated Sites (6010B, 6020, 8260B, PCBs, PAHs)	UST-078	8/10/2013
Alaska	Dept. of Environmental Conservation	Dioxin-DW	MN00064	6/30/2013
Arizona	Dept of Health Services	Air, Dioxin-DW, WW, HW, Envir-DW, WW, HW	AZ0014	12/14/2013
Arkansas	Dept of Environmental Quality	Dioxins	88-0680	6/19/2013
California	Dept of Health Services	Dioxin-DW, WW, HW	01155CA	8/31/2013
		Envir-DW, WW, HW		
Colorado	Dept. of Public Health & Environment	Dioxin-DW	Pace Analytical	12/31/2013
Connecticut	Dept of Public Health	Dioxins	PH-0256	12/31/2013
Delaware	Health & Social Services	Dioxin-DW		
EPA Region 5	Water Division	Dioxin-DW	WD-15J	2/17/2014
EPA Region 8	Water Division	Dioxin-DW, Env-DW		12/31/2013
Florida (NELAP)	Dept of Health Services	Diox-DW, WW, HW, Air	E87605	6/30/2013
		Envir-DW, WW, HW, Air		
Georgia	Environmental Protection Division	Dioxin-WW, HW via NELAP		12/31/2013
Georgia	Dept of Natural Resources	Dioxin-DW	959	12/31/2013
Guam	Guam EPA	Dioxin-DW	Pace Analytical	10/21/2013
Idaho	Dept. of Health & Welfare	Dioxin-DW	MN00064	12/31/2013
Hawaii	Dept of Health	Dioxin-DW	MN00064	12/31/2013
Illinois	Illinois EPA	Dioxin-DW, HW, WW via NELAP	200011	12/11/2013
Indiana	Dept of Health	Dioxin-DW via EPA Region 5	C-MN-01	12/31/2013
Iowa	Dept.of Natural Resources	Envir.-DW, WW, UST	368	6/1/2013
Kansas	Dept of Health and Environment	Dioxin-DW, Envir-DW, WW, HW	E-10167	10/31/2013
Kentucky	Dept of Environmental Protection	Dioxin-DW	90062	12/31/2013
Louisiana DEQ	Department of Environmental Quality	Dioxin-WW, HW, Air	3086	6/30/2013
Louisiana DHH	Department of Health and Hospitals	Dioxin-DW	LA090015	12/31/2013
Maine	Dept of Human Services	Dioxin-DW via EPA Region 5	2007029	5/27/2015
Maryland	Dept. of Heath and Mental Hygiene	Dioxin-DW	322	6/30/2013
Michigan	Dept. of Public Health	Dioxin-DW, ICPMS, 524.2	9909	12/31/2013
Minnesota	Dept of Health	Envir-DW, WW, HW	027-053-137	12/31/2013
Minnesota	Department of Commerce	Petrofund	1240	4/16/2013
Mississippi	Dept. of Health and Environmental Control	Dioxin-DW	Pace	12/31/2013
Montana	Dept of Health	Dioxin-DW, Envir-DW	92	1/1/2014
Nebraska	Dept. of Health & Human Services.	Dioxin-DW	Pace	12/31/2013
Nevada	Health Division	Dioxin-DW, WW	MN_00064_2000_72	7/31/2013 ext
New Jersey	Dept of Environmental Protection	Dioxin-DW, WW, HW	MN002	6/30/2013
		Envir-WW, HW, Air		
New York	Dept of Health	Dioxin-DW, WW, Air	11647	4/1/2014
North Carolina	Dept of Environment, Health and Natural Resources	Envir-WW, HW	530	12/31/2013
North Carolina	State Public Health Laboratory	Dioxin-DW	27700	7/31/2013
North Dakota	Dept of Health and Consolidated Labs	Envir-DW, WW, HW	R-036	12/31/2013

ATTACHMENT VI- LABORATORY CERTIFICATION LIST CONTINUED (CURRENT AS OF ISSUE DATE)

SCOPE AND APPLICATION CERTIFICATES ARE MAINTAINED AND FILED IN THE LOCAL QUALITY DEPARTMENT

Ohio	Ohio EPA	Dioxin-DW via EPA Region 5	4150	2/17/2014
Ohio Vap	VAP	Air	CL101	5/2/2014
Oklahoma	Dept of Environmental Quality	Dioxin, DW, Envir-HW	9507	8/31/2013
Oregon	ELAP	Dioxin-DW, WW, HW, Air Enviro: Air	MN200001-005	8/14/2013
Oregon			MN300001-001	5/25/2013
Pennsylvania	Dept of Environmental Protection	Dioxin-DW, WW, HW, Envir: DW, WW, HW	68-00563	3/31/2014
Puerto Rico		Dioxin, DW metals		1/30/2014
Saipan (CNMI)	Div. Of Environmental Quality	Dioxin-DW	MP0003	12/31/2013
South Carolina	Dept. of Health and Environmental Control	Dioxin-DW, WW, HW	74003001	12/31/2013
South Dakota		Dioxin-DW, DW		
Texas	Department of Health	Dioxin-DW, WW, HW	T104704192-08A-TX	2/28/2014
Tennessee	Dept of Health	Dioxin-DW, Envir-DW	2818	12/31/2013
Utah	Department of Health	Dioxin-DW, WW, HW	ID# PAM Account# 6126071700	6/30/2013
Virginia	Dept of General Services	Dioxin-DW	251	6/30/2013
Virginia - ELAP	VELAP			6/14/2013
Washington	Dept of Ecology	Dioxin-DW, WW, HW Envir-DW, WW, HW	C486	2/18/2014
Wisconsin	Dept of Natural Resources	Dioxin-DW, WW, HW, Envir-DW, WW, HW	999407970	8/31/2013
Wyoming	Via EPA Region 8	Dioxin DW, Envir-Metals DW		12/31/2013
West Virginia	Dept of Env. Protection	Dioxin - HW, WW Env - Metals - HW, WW	382	8/31/2013
West Virginia	Dept of Health and Human Resources	TO15		6/30/2013
West Virginia	Dept of Health and Human Resources	Dioxin-DW	9952C	12/31/2013
EPA ID: MT00012				
State	**Agency**	**Program**	**Cert #**	**Expiration**
Colorado-MT		Asbestos Registration	17119	3/15/2014
EPA Region 8-MT Lab	Water Division	DW		12/31/2013
Idaho-MT Lab	Dept. of Health & Welfare	DW	MT00012	6/30/2013
Minnesota - MT		Envir-DW, WW	11610AA	12/31/2013
Montana-MT Lab	Dept of Health	DW	40	12/31/2013
NVLAP-MT Lab		Asbestos	101292-0	3/31/2014

ATTACHMENT VII- PACE CHAIN-OF-CUSTODY (CURRENT AS OF ISSUE DATE)

ATTACHMENT VIII- METHOD HOLD TIME, CONTAINER AND PRESERVATION GUIDE (CURRENT AS OF ISSUE DATE)

THE HOLDING TIME INDICATED IN THE CHART BELOW IS THE MAXIMUM ALLOWABLE TIME FROM COLLECTION TO EXTRACTION AND/OR ANALYSIS PER THE ANALYTICAL METHOD. FOR METHODS THAT REQUIRE PROCESSING PRIOR TO ANALYSIS, THE HOLDING TIME IS DESIGNATED AS 'PREPARATION HOLDING TIME/ANALYSIS HOLDING TIME'.

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Acidity	SM2310B	Water	Plastic/Glass	≤ 6°C	14 Days
Actinides	HASL-300	Water		pH<2 HNO_3	180 Days
Actinides	HASL-300	Solid		None	180 Days
Alkalinity	SM2320B/310.2	Water	Plastic/Glass	≤ 6°C	14 Days
Alkylated PAHs		Water		≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved
Alkylated PAHs		Solid		≤ 10°C	1 Year/40 Days
Total Alpha Radium (see note 3)	9315/903.0	Water	Plastic/Glass	pH<2 HNO_3	180 days
Total Alpha Radium (see note 3)	9315	Solid		None	180 days
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4, bromate, chlorite, chlorate)	300.0/300.1/SM4110B	Water	Plastic/Glass	≤ 6°C; EDA if bromate or chlorite run	All analytes 28 days except: NO_2, NO_3, o-Phos (48 Hours); chlorite (immediately for 300.0; 14 Days for 300.1). NO_2/NO_3 combo 28 days.
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4, bromate, chlorite, chlorate)	300.0	Solid	Plastic/Glass	≤ 6°C	All analytes 28 days except: NO_2, NO_3, o-Phos (48 hours); chlorite (immediately). NO_2/NO_3 combo 28 days.
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4	9056	Water/ Solid	Plastic/Glass	≤ 6°C	28 days
Aromatic and Halogenated Volatiles (see note 1)	8021	Solid	5035 vial kit	See note 1	14 days
Aromatic and Halogenated Volatiles	602/8021	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days (7 Days for aromatics if unpreserved)
Acid Volatile Sulfide	Draft EPA 1629	Solid	8oz Glass	≤ 6°C	14 Days
Bacteria, Total Plate Count	SM9221D	Water	Plastic/WK	≤ 6°C; $Na_2S_2O_3$	24 Hours

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Base/Neutrals and Acids	8270	Solid	8oz Glass	≤ 6°C	14/40 Days
Base/Neutrals and Acids	625/8270	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Base/Neutrals, Acids & Pesticides	525.2	Water	1L Amber Glass	pH<2 HCl; ≤ 6°C; Na sulfite if Cl present	14/30 Days
Biomarkers		Water	≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	≤ 6°C; pH<2 1:1 HCl (optional)
Biomarkers		Solid	≤ 10°C	1 Year/40 Days	≤ 10°C
BOD/cBOD	SM5210B	Water	Plastic/Glass	≤ 6°C	48 hours
BTEX/Total Hydrocarbons	TO-3	Air	Summa Canister	None	14 Days
BTEX/Total Hydrocarbons	TO-3	Air	Tedlar Bag or equivalent	None	48 Hours
Cation/Anion Balance	SM1030E	Water	Plastic/Glass	None	None
Cation Exchange	9081	Solid	8oz Glass	None	unknown
Chloride	SM4500Cl-C,E	Water	Plastic/Glass	None	28 Days
Chlorine, Residual	SM4500Cl-D,E,G/330.5/Hach 8167	Water	Plastic/Glass	None	15 minutes
Chlorophyll	SM10200H	Water	Opaque bottle or aluminum foil		
COD	SM5220C, D/410.4/Hach 8000	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Coliform, Fecal	SM9222D	Water	100mL Plastic	≤ 6°C	6 Hours
Coliform, Fecal	SM9222D	Solid	100mL Plastic	≤ 6°C	6 Hours
Coliform, Total and Escherichla (E. coli)	SM9223B	Water	100mL Plastic	≤ 10°C	48 Hours after collection; results from samples analyzed 30-48 Hours after collection must be qualified as analyzed >30 hours
Color	SM2120B,E	Water	Covered Plastic/Acid Washed Amber Glass	≤ 6°C	24 Hours
Condensable Particulate	EPA 202	Air	Solutions	None	180 Days

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Emissions					
Cyanide, Reactive	SW846 chap.7	Water	Plastic/Glass	None	28 Days
Cyanide, Reactive	SW846 chap.7	Solid	Plastic/Glass	None	28 Days
Cyanide, Total and Amenable	SM4500CN-A,B,C,D,E,G,I,N/9010/9012/335.4	Water	Plastic/Glass	pH≥12 NaOH; ≤ 6°C; ascorbic acid if Cl present	14 Days (24 Hours if sulfide present-applies to SM4500CN only)
Diesel Range Organics- Alaska DRO	AK102	Solid	8oz Glass	≤ 6°C	14/40 Days
Diesel Range Organics- Alaska DRO	AK102	Water	1L Glass	pH<2 HCl; ≤ 6°C	14/40 Days
Diesel Range Organics- TPH DRO	8015	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Diesel Range Organics- TPH DRO	8015	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Diesel Range Organics- TPH DRO	8015	Tissue	1L Amber Glass	≤ - 10°C	1 Year if frozen/40 Days
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Water	1L Amber Glass	pH <2 HCl; ≤ 6°C	14/40 Days; 7 Days from collection to extraction if unpreserved
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Solid	Tared 4oz Glass Jar	≤ 6°C	10/47 Days
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Water	1L Amber Glass	≤ 6°C	14/40 Days
Dioxins and Furans	1613B	Solid	8oz Glass	≤ 6°C	1 year
Dioxins and Furans	1613B	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	1 year
Dioxins and Furans	1613B	Fish/ Tissue	Aluminum foil	≤ 6°C	1 year
Dioxins and Furans	8290	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	30/45 Days
Dioxins and Furans	8290	Solid	8oz Glass	≤ 6°C	30/45 Days
Dioxins and Furans	8290	Fish/ Tissue	Not specified	< -10°C	30/45 Days
Dioxins and Furans	TO-9	Air	PUF	None	30/45 Days
EDB/DBCP (8011) EDB/DBCP/1,2,3-TCP (504.1)	504.1/8011	Water	40mL vials	≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days
Explosives	8330/8332	Water	1L Amber	≤ 6°C	7/40 Days

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
			Glass		
Explosives	8330/8332	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Extractable Petroleum Hydrocarbons (aliphatic and aromatic)	MA-EPH	Water	1L Amber Glass	pH<2 HCl; ≤ 6°C	14/40 Days
Extractable Petroleum Hydrocarbons (aliphatic and aromatic)	MA-EPH	Solid	4oz Glass Jar	≤ 6°C	7/40 Days
Ferrous Iron	SN3500Fe-D	Water	Glass	None	Immediate
Flashpoint/Ignitability	1010	Liquid	Plastic/Glass	None	28 Days
Fluoride	SM4500Fl-C,D	Water	Plastic	None	28 Days
Gamma Emitting Radionuclides	901.1	Water	Plastic/Glass	pH<2 HNO_3	180 days
Gasoline Range Organics	8015	Water	40mL vials	pH<2 HCl	14 Days
Gasoline Range Organics	8015	Solid	5035 vial kit	See note 1	14 days
Gasoline Range Organics-Alaska GRO	AK101	Solid	5035 vial kit	See 5035 note*	28 Days if GRO only (14 Days with BTEX)
Gasoline Range Organics-Alaska GRO	AK101	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days
Gasoline Range Organics-NwTPH-Gx	Nw-TPH-Gx	Water	40mL vials	pH<2 HCl; ≤ 6°C	7 Days unpreserved; 14 Days preserved
Gasoline Range Organics-NwTPH-Gx	Nw-TPH-Gx	Solid	40mL vials	≤ 6°C; packed jars with no headspace	14 Days
Gasoline Range Organics-Wisconsin GRO	WI MOD GRO	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days
Gasoline Range Organics-Wisconsin GRO	WI MOD GRO	Solid	40mL MeOH vials	≤ 6°C in MeOH	21 Days
Gross Alpha (NJ 48Hr Method)	NJAC 7:18-6	Water	Plastic/Glass	pH<2 HNO_3	48 Hrs
Gross Alpha and Gross Beta	9310/900.0	Water	Plastic/Glass	pH<2 HNO_3	180 Days
Gross Alpha and Gross Beta	9310	Solid	Glass	None	180 Days
Haloacetic Acids	552.1/552.2	Water	40mL Amber vials	NH_4Cl; ≤ 6°C	14/7 Days if extracts stored ≤ 6°C or 14/14 Days if extracts stored at ≤ -10°C
Hardness, Total ($CaCO_3$)	SM2340B,C/130.1	Water	Plastic/Glass	pH<2 HNO_3	6 Months
Heterotrophic Plate Count (MPC)	SM9215B	Water	100mL Plastic	≤ 6°C	24 Hours
Herbicides, Chlorinated	8151	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Herbicides, Chlorinated	8151	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Herbicides, Chlorinated	515.1/515.3	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl	14/28 Days

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
				present	
Hexavalent Chromium	7196/218.6/SM3500Cr-C,D	Water	Plastic/Glass	≤ 6°C	24 Hours
Hexavalent Chromium	7196 (with 3060A)	Solid		≤ 6°C	24 Hours after extraction
Hydrogen Halide and Halogen Emissions	EPA 26	Air	Solutions	None	6 Months
Ignitability of Solids	1030	Non-liquid Waste	Plastic/Glass	None	28 Days
Lead Emissions	EPA 12	Air	Filter/Solutions	None	6 Months
Lipids	Pace Lipids	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen
Mercury, Low-Level	1631E	Solid			
Mercury, Low-Level	1631E	Water	Fluoropolymer bottles (Glass if Hg is only analyte being tested)	12N HCl or BrCl	48 Hours for preservation or analysis; 28 Days to preservation if sample oxidized in bottle; 90 Days for analysis if preserved
Mercury, Low-Level	1631E	Tissue	Plastic/Glass	≤ - 10°C	28 Days if frozen
Mercury	7471	Solid	8oz Glass Jar	≤ 6°C	28 days
Mercury	7470/245.1/245.2	Water	Plastic/Glass	pH<2 HNO_3	28 Days
Mercury	7471/245.6	Tissue	Plastic/Glass	≤ - 10°C	28 Days if frozen
Metals (GFAA)	7000/200.9	Water	Plastic/Glass	pH<2 HNO_3	180 Days
Metals (ICP)	NIOSH 7300A/7303	Air	Filters	None	180 Days
Metals (ICP/ICPMS)	6010/6020	Solid	8oz Glass Jar	None	180 Days
Metals (ICP/ICPMS)	6010/6020/200.7/200.8	Water	Plastic/Glass	pH<2 HNO_3	180 Days
Metals (ICP/ICPMS)	6020	Tissue	Plastic/Glass	≤ -10°C	180 Days if frozen
Methane, Ethane, Ethene	8015 modified	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	RSK-175	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Summa Canister	None	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours
Methanol, Ethanol	8015 modified	Water	40mL vials	≤ 6°C	14 Days
Methanol, Ethanol	8015 modified	Solid	2oz Glass	≤ 6°C	14 Days
Nitrogen, Ammonia	SM4500NH3/350.1	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Nitrogen, Kjeldahl (TKN)	351.2	Solid	Plastic/Glass	≤ 6°C	28 Days
Nitrogen, Kjeldahl (TKN)	SM4500-Norg/351.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Nitrogen, Nitrate	SM4500-NO3/352.1	Water	Plastic/Glass	≤ 6°C	24 Hours preferred
Nitrogen, Nitrate & Nitrite	353.2	Solid	Plastic/Glass	≤ 6°C	28 Days

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
combination					
Nitrogen, Nitrate & Nitrite combination	SM4500-NO3/353.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Nitrogen, Nitrite or Nitrate separately	SM4500-NO2/353.2	Water	Plastic/Glass	≤ 6°C	48 Hours
Nitrogen, Organic	SM4500-Norg/351.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Non-Methane Organics	EPA 25C	Air	Summa Canister	None	14 Days
Non-Methane Organics	EPA 25C	Air	Tedlar Bag or equivalent	None	48 Hours
Odor	SM2150B	Water	Glass	≤ 6°C	24 Hours
Oil and Grease/HEM	1664A/SM5520B/9070	Water	Glass	pH<2 H_2SO_4 or HCl; ≤ 6°C	28 Days
Oil and Grease/HEM	9071	Solid	Glass	≤ 6°C	28 Days
PBDEs	1614	Water	1L Amber Glass	≤ 6°C	1 Year/1 Year
PBDEs	1614	Solid	Wide Mouth Jar	≤ 6°C	1 Year/1 Year
PBDEs	1614	Tissue	Aluminum Foil	≤ -10°C	1 Year/1 Year
PCBs and Pesticides, Organochlorine (OC)	TO-4/TO-10	Air	PUF	None	7/40 Days
PCBs and Pesticides, Organochlorine (OC)	608	Water	1L Amber Glass		Pest: 7/40 Days; PCB: 1 Year/1 Year
Pesticides, Organochlorine (OC)	8081	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Pesticides, Organochlorine (OC)	8081	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Pesticides, Organochlorine (OC)	8081	Tissue	8oz Glass Jar	≤ -10°C	1 Year if frozen/40 Days
Pesticides, Organophosphorous (OP)	8141	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Pesticides, Organophosphorous (OP)	8141	Water	1L Amber Glass	pH 5-8 with NaOH or H_2SO_4; ≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
PCBs (Aroclors)	8082	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	1 Year/1 Year
PCBs (Aroclors)	8082	Solid	8oz Glass Jar	≤ 6°C	1 Year/1 Year
PCBs (Aroclors)	8082	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen/1 Year
PCB Congeners	1668A	Water	1L Amber Glass	≤ 6°C but above	1 Year/1 Year

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
				freezing	
PCB Congeners	1668A	Solid	4-8oz Glass Jar	≤ 6°C but above freezing	1 Year/1 Year
PCB Congeners	1668A	Tissue	4-8oz Glass Jar	≤ -10°C	1 Year/1 Year
Oil Range Organics- ORO					
Oxygen, Dissolved (Probe)	SM4500-O	Water	Glass	None	15 minutes
Paint Filter Liquid Test	9095	Water	Plastic/Glass	None	N/A
Particulates	PM-10	Air	Filters	None	180 Days
Permanent Gases	EPA 3C	Air	Summa Canister	None	14 Days
Permanent Gases	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours
pH	SM4500H+B/9040	Water	Plastic/Glass	None	15 minutes
pH	9045	Solid	Plastic/Glass	None	
Phenol, Total	420.1/420.4/9065/9066	Water	Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Phosphorus, Orthophosphate	SM4500P/365.1/365.3	Water	Plastic	Filter; ≤ 6°C	Filter within 15 minutes, Analyze within 48 Hours
Phosphorus, Total	SM4500P/ 365.1/365.3/365.4	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days
Phosphorus, Total	365.4	Solid	Plastic/Glass	≤ 6°C	28 Days
Polynuclear Aromatic Hydrocarbons (PAH)	TO-13	Air	PUF	None	7/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen/40 Days
Radioactive Strontium	905.0	Water	Plastic/Glass	pH<2 HNO_3	180 days
Radium-226	903.0/903.1	Water	Plastic/Glass	pH<2 HNO_3	180 days
Radium-228 (see note 3)	9320/904.0	Water	Plastic/Glass	pH<2 HNO_3	180 days
Radium-228 (see note 3)	9320	Solid			
Residual Range Organics- Alaska RRO	AK103	Solid	8oz Glass	≤ 6°C	14/40 Days
Saturated Hydrocarbons		Water	≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	≤ 6°C; pH<2 1:1 HCl (optional)
Saturated Hydrocarbons		Solid	≤ 10°C	1 Year/40 Days	≤ 10°C
Silica, Dissolved	SM4500Si-D	Water	Plastic	≤ 6°C	28 Days
Solids, Settleable	SM2540F	Water	Glass	≤ 6°C	48 Hours

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Solids, Total	SM2540B	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total	SM2540G	Solid	Plastic/Glass	≤ 6°C	7 Days
Solids, Total (FOC, OM, Ash)	ASTM D2974	Solid	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Dissolved	SM2540C	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Suspended	SM2540D/USGS I-3765-85	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Volatile	160.4/SM2540E	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Volatile	160.4	Solid	Plastic/Glass	≤ 6°C	7 Days
Specific Conductance	SM2510B/9050/120.1	Water	Plastic/Glass	≤ 6°C	28 Days
Stationary Source Dioxins and Furans	EPA 23	Air	XAD Trap	None	30/45 Days
Stationary Source Mercury	EPA 101	Air	Filters	None	180 Days, 28 Days for Hg
Stationary Source Metals	EPA 29	Air	Filters	None	180 Days, 28 Days for Hg
Stationary Source PM10	EPA 201A	Air	Filters	None	180 Days
Stationary Source Particulates	EPA 5	Air	Filter/Solutions	None	180 Days
Sulfate	SM4500SO4/9036/9038/375.2/ASTM D516	Water	Plastic/Glass	≤ 6°C	28 Days
Sulfide, Reactive	SW-846 Chap.7	Water	Plastic/Glass	None	28 Days
Sulfide, Reactive	SW-846 Chap.7	Solid	Plastic/Glass	None	28 Days
Sulfide, Total	SM4500S/9030	Water	Plastic/Glass	pH>9 NaOH; ZnOAc; ≤ 6°C	7 Days
Sulfite	SM4500SO3	Water	Plastic/Glass	None	15 minutes
Surfactants (MBAS)	SM5540C	Water	Plastic/Glass	≤ 6°C	48 Hours
Total Organic Carbon (TOC)	SM5310B,C,D/9060	Water	Glass	pH<2 H_2SO_4 or HCl; ≤ 6°C	28 Days
Total Organic Carbon (TOC)	9060/Walkley Black	Solid	Glass	≤ 6°C	14 Days
Total Organic Halogen (TOX)	SM5320/9020/9021	Water	Glass; no headspace	≤ 6°C	14 Days
Tritium	906.0	Water	Glass	None	180 days
Turbidity	SM2130B/180.1	Water	Plastic/Glass	≤ 6°C	48 Hours
Total Uranium	908.0/ASTM D5174-97	Water	Plastic/Glass	pH<2 HCl	180 days
Volatile Petroleum Hydrocarbons (aliphatic and aromatic)	MA-VPH	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days preserved
Volatile Petroleum Hydrocarbons (aliphatic and aromatic)	MA-VPH	Solid	4-8oz Glass Jar	≤ 6°C; packed jars with no headspace	7/28 Days
Volatiles	TO-14	Air	Summa Canister	None	30 Days
Volatiles	TO-14	Air	Tedlar Bag or	None	48 Hours

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
			equivalent		
Volatiles	TO-15	Air	Summa Canister	None	30 Days
Volatiles	8260	Solid	5035 vial kit	See note 1	14 days
Volatiles	8260	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days
Volatiles	8260	Conc. Waste	5035 vial kit or 40mL vials	≤ 6°C	14 Days
Volatiles	624	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days (7 Days for aromatics if unpreserved)
Volatiles (see note 2)	524.2	Water	40mL vials (in duplicate)	pH<2 HCl; ≤ 6°C; Ascorbic acid or $Na_2S_2O_3$ if Cl present[2]	14 Days

[1] **5035/5035A Note**: 5035 vial kit typically contains 2 vials water, preserved by freezing or, 2 vials aqueous sodium bisulfate preserved at 4°C, and one vial methanol preserved at ≤6°C and one container of unpreserved sample stored at ≤6°C.

[2] Method 524.2 lists ascorbic acid as the preservative when residual chlorine is suspected, unless gases or Table 7 compounds are NOT compounds of interest and then sodium thiosulfate is the preservative recommended.

[3] Methods 9315 and 9320 both state that if samples are unpreserved, the samples should be brought to the lab within 5 days of collection, preserved in the lab, and then allowed to sit for a minimum of 16 hours before sample preparation/analysis.

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED
ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

PACE ANALYTICAL SERVICES - MN

1700 ELM STREET, SUITE 200

MINNEAPOLIS, MN 55414

NELAP ACCREDITED

ACCREDITATION NUMBER #200011

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Primary Accrediting Authority: MN Department of Health, ELAP

Celeste M. Crowley
Acting Manager
Environmental Laboratory Accreditation Program

Janet Cruse
Accreditation Officer
Environmental Laboratory Accreditation Program

Certificate No.: 003299
Expiration Date: 12/11/2014
Issued On: 10/23/2013

State of Illinois
Environmental Protection Agency

Certificate No.: 003299

Awards the Certificate of Approval to:

Pace Analytical Services - MN
1700 Elm Street, Suite 200
Minneapolis, MN 55414

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

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FOT Name: Drinking Water, Inorganic

Method: ASTM D516-90

Matrix Type: Potable Water

Sulfate

Method: SM2320B,20Ed

Matrix Type: Potable Water

Alkalinity

Method: SM2340B,20Ed

Matrix Type: Potable Water

Hardness

Method: SM2510B,20Ed

Matrix Type: Potable Water

Conductivity

Method: SM2540C,20Ed

Matrix Type: Potable Water

Total Dissolved Solids

Method: SM4500Cl-G,20Ed

Matrix Type: Potable Water

Chlorine (free, combined, total)

Method: SM4500CN-CE,20Ed

Matrix Type: Potable Water

Cyanide

Method: SM4500F-C,20Ed

Matrix Type: Potable Water

Fluoride

Method: SM4500H-B,20Ed

Matrix Type: Potable Water

Hydrogen Ion (pH)

Method: SM4500NO2-B,20Ed

Matrix Type: Potable Water

Pace Analytical Services - MN
1700 Elm Street, Suite 200
Minneapolis, MN 55414

FOT Name: Drinking Water, Inorganic

Matrix Type: Potable Water

Method: SM4500P-E,20Ed

Matrix Type: Potable Water

Orthophosphate

Method: USEPA180.1

Matrix Type: Potable Water

Turbidity

Method: USEPA200.8R5.4

Matrix Type: Potable Water

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

Method: USEPA245.1R3.0

Matrix Type: Potable Water

Mercury

Method: USEPA300.0R2.1

Matrix Type: Potable Water

Chloride
Fluoride
Nitrate
Nitrite
Sulfate

Method: USEPA353.2R2.0

Matrix Type: Potable Water

Nitrate
Nitrite

FOT Name: Drinking Water, Organic

Method: USEPA1613RB

Matrix Type: Potable Water

Dioxin (2,3,7,8 TCDD)

Method: USEPA524.2R4.1

Matrix Type: Potable Water

Method: SM4500NO2-B,20Ed

Nitrite

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FOT Name: Drinking Water, Organic

Method: USEPA524.2R4.1

Matrix Type: Potable Water

1,1,1-Trichloroethane	1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane	1,1,2,2-Tetrachloroethane
1,1-Dichloroethene	1,1-Dichloroethane
1,2,3-Trichlorobenzene	1,1-Dichloropropene
1,2,4-Trichlorobenzene	1,2,3-Trichloropropane
1,2-Dichlorobenzene	1,2,4-Trimethylbenzene
1,2-Dichloropropane	1,2-Dichloroethane
1,4-Dichlorobenzene	1,3-Dichlorobenzene
2-Chlorotoluene	2,2-Dichloropropane
Benzene	4-Chlorotoluene
Bromochloromethane	Bromobenzene
Bromoform	Bromodichloromethane
Carbon tetrachloride	Bromomethane
Chlorodibromomethane	Chlorobenzene
Chloroform	Chloroethane
cis-1,2-Dichloroethene	Chloromethane
Dibromomethane	cis-1,3-Dichloropropene
Dichloromethane (Methylene chloride)	Dichlorodifluoromethane
Fluorotrichloromethane	Ethylbenzene
Isopropylbenzene	Hexachlorobutadiene
Naphthalene	Methyl tert-butyl ether (MTBE)
n-Propylbenzene	n-Butylbenzene
Styrene	sec-Butylbenzene
Tetrachloroethene	tert-Butylbenzene
Total trihalomethanes	Toluene
trans-1,3-Dichloropropene	trans-1,2-Dichloroethene
Vinyl chloride	Trichloroethylene
	Xylenes (total)

FOT Name: Non Potable Water, Inorganic

Method: Hach 10360

Matrix Type: NPW

Biochemical Oxygen Demand (BOD5)	Carbonaceous Biochemical Oxygen Demand (CBOD5
Oxygen - Dissolved	

Method: SM2320B,1997

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FOT Name: Non Potable Water, Inorganic

Method: SM2320B,1997

Matrix Type: NPW

Alkalinity

Method: SM2340B,1997

Matrix Type: NPW

Hardness

Method: SM2510B,1997

Matrix Type: NPW

Specific Conductance

Method: SM2540B,1997

Matrix Type: NPW

Residue (Total)

Method: SM2540C,1997

Matrix Type: NPW

Residue (TDS)

Method: SM2540D,1997

Matrix Type: NPW

Residue (TSS)

Method: SM2540F,1997

Matrix Type: NPW

Residue (settleable)

Method: SM3500Cr-B,2009

Matrix Type: NPW

Chromium VI

Method: SM4500CL-E,1997

Matrix Type: NPW

Chloride

Method: SM4500Cl-G,2000

Matrix Type: NPW

Chlorine, Total Residual

Method: SM4500CN-E,1999

Matrix Type: NPW

Cyanide

Method: SM4500CN-G,1999

Matrix Type: NPW

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FOT Name: Non Potable Water, Inorganic

Matrix Type: NPW

Method: SM4500F-C,1997

Fluoride

Method: SM4500H-B,2000

Hydrogen Ion (pH)

Method: SM4500NO2-B,2000

Nitrite

Method: SM4500NO3-H,2000

Nitrate-Nitrite (as N)

Method: SM4500P-E,1999

Orthophosphate (as P)

Method: SM5220D,1997

Chemical Oxygen Demand (COD)

Method: USEPA120.1,1982

Specific Conductance

Method: USEPA160.4,1971

Residue (Volatile)

Method: USEPA1664A

Oil and Grease

Method: USEPA180.1R2.0,1993

Turbidity

Method: USEPA200.7,1994

Aluminum

Method: SM4500CN-G,1999

Cyanide, Available

Phosphorus

Antimony

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FOT Name: Non Potable Water, Inorganic

Matrix Type: NPW

Method: USEPA200.7,1994

- Barium
- Boron
- Calcium
- Cobalt
- Iron
- Magnesium
- Molybdenum
- Potassium
- Silver
- Thallium
- Vanadium
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Selenium
- Sodium
- Tin
- Zinc

Method: USEPA200.8,1994

Matrix Type: NPW

- Aluminum
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Selenium
- Sodium
- Tin
- Vanadium
- Antimony
- Barium
- Boron
- Calcium
- Cobalt
- Iron
- Magnesium
- Molybdenum
- Potassium
- Silver
- Thallium
- Titanium
- Zinc

Method: USEPA245.1R3.0,1994

Matrix Type: NPW

- Mercury

Method: USEPA300.0R2.1,1993

Matrix Type: NPW

- Bromide
- Fluoride
- Chloride
- Nitrate

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FOT Name: Non Potable Water, Inorganic

Matrix Type: NPW

Sulfate

Method: USEPA350.1R2.0,1993

Matrix Type: NPW

Ammonia

Method: USEPA353.2R2.0,1993

Matrix Type: NPW

Nitrate

Nitrite (as N)

Method: USEPA410.4R2.0,1993

Matrix Type: NPW

Chemical Oxygen Demand (COD)

Method: USEPA420.1,1978

Matrix Type: NPW

Phenolics

Method: USEPA420.4R1.0,1993

Matrix Type: NPW

Phenolics

Method: USEPA300.0R2.1,1993

Nitrite

Nitrate-nitrite (as N)

FOT Name: Non Potable Water, Organic

Method: USEPA1613B

Matrix Type: NPW/SCM

1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8,9-Heptachlorodibenzofuran
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
1,2,3,7,8-Pentachlorodibenzo-p-dioxin
2,3,4,7,8-Pentachlorodibenzofuran
2,3,7,8-Tetrachlorodibenzo-p-dioxin
Octachlorodibenzo-p-dioxin
Total Heptachlorodibenzo-p-dioxin
Total Hexachlorodibenzo-p-dioxin
Total Pentachlorodibenzo-p-dioxin
Total Tetrachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8,9-Hexachlorodibenzofuran
1,2,3,7,8-Pentachlorodibenzofuran
2,3,4,6,7,8-Hexachlorodibenzofuran
2,3,7,8-Tetrachlorodibenzofuran
Octachlorodibenzofuran
Total Heptachlorodibenzofuran
Total Hexachlorodibenzofuran
Total Pentachlorodibenzofuran
Total Tetrachlorodibenzofuran

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FOT Name: Non Potable Water, Organic

Method: USEPA624

Matrix Type: NPW

1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane	1,1-Dichloroethane
1,1-Dichloroethene	1,2-Dichlorobenzene
1,2-Dichloroethane	1,2-Dichloropropane
1,3-Dichlorobenzene	1,4-Dichlorobenzene
2-Chloroethylvinyl ether	Acrylonitrile
Benzene	Bromodichloromethane
Bromoform	Bromomethane
Carbon tetrachloride	Chlorobenzene
Chloroethane	Chloroform
Chloromethane	cis-1,3-Dichloropropene
Dibromochloromethane	Dichloromethane (Methylene chloride)
Ethylbenzene	Tetrachloroethene
Toluene	trans-1,2-Dichloroethene
trans-1,3-Dichloropropene	Trichloroethene
Trichlorofluoromethane	Vinyl chloride

Method: USEPA625

Matrix Type: NPW

1,2,4-Trichlorobenzene	2,4,5-Trichlorophenol
2,4,6-Trichlorophenol	2,4-Dichlorophenol
2,4-Dimethylphenol	2,4-Dinitrophenol
2,4-Dinitrotoluene (2,4-DNT)	2,6-Dinitrotoluene (2,6-DNT)
2-Chloronaphthalene	2-Chlorophenol
2-Methyl-4,6-dinitrophenol	2-Nitrophenol
3,3'-Dichlorobenzidine	4-Bromophenyl phenyl ether
4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether
4-Nitrophenol	Acenaphthene
Acenaphthylene	Anthracene
Benzidine	Benzo(a)anthracene
Benzo(a)pyrene	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	Benzo(k)fluoranthene
Benzyl butyl phthalate	Bis(2-chloroethoxy) methane
Bis(2-chloroethyl) ether	Bis(2-ethylhexyl) phthalate
Chrysene	Dibenz(a,h)anthracene

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FOT Name: Non Potable Water, Organic

Method: USEPA625

Matrix Type: NPW

- Dimethyl phthalate
- Diethyl phthalate
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Hexachloroethane
- Indeno(1,2,3-cd) pyrene
- Isophorone
- Naphthalene
- Nitrobenzene
- N-Nitrosodimethylamine
- N-Nitrosodi-n-propylamine
- N-Nitrosodiphenylamine
- Pentachlorophenol
- Phenanthrene
- Phenol
- Pyrene

FOT Name: Solid and Chemical Materials, Inorganic

Method: 1311

Matrix Type: NPW/SCM

- TCLP (Organic and Inorganic)

Method: 1312

Matrix Type: NPW/SCM

- Synthetic Precipitation Leaching Procedure

Method: 6010B

Matrix Type: NPW/SCM

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Tin
- Titanium
- Vanadium
- Zinc

Method: 6010C

State of Illinois
Environmental Protection Agency

Certificate No.: 003299

Awards the Certificate of Approval

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FOT Name: Solid and Chemical Materials, Inorganic — **Method: 6010C**

Matrix Type: NPW/SCM

Aluminum	Antimony
Arsenic	Barium
Beryllium	Boron
Cadmium	Calcium
Chromium	Cobalt
Copper	Iron
Lead	Magnesium
Manganese	Molybdenum
Nickel	Potassium
Selenium	Silver
Sodium	Thallium
Tin	Titanium
Vanadium	Zinc

Method: 6020A

Matrix Type: NPW/SCM

Aluminum	Antimony
Arsenic	Barium
Beryllium	Boron
Cadmium	Calcium
Chromium	Cobalt
Copper	Iron
Lead	Magnesium
Manganese	Molybdenum
Nickel	Potassium
Selenium	Silver
Sodium	Thallium
Vanadium	Zinc

Method: 7470A

Matrix Type: NPW

Mercury

Method: 7471B

Matrix Type: SCM

Mercury

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FOT Name: Solid and Chemical Materials, Inorganic **Method: 9045D**

Matrix Type: SCM

Hydrogen Ion (pH)

Method: 9071B

Matrix Type: SCM

Oil and Grease Extractable

Method: 9095B

Matrix Type: SCM

Paint Filter

FOT Name: Solid and Chemical Materials, Organic

Method: 8015B

Matrix Type: NPW/SCM

Diesel range organics (DRO) Gasoline range organics (GRO)

Method: 8015C

Matrix Type: NPW/SCM

Diesel range organics (DRO) Gasoline range organics (GRO)

Method: 8021B

Matrix Type: NPW/SCM

1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene
Benzene Ethylbenzene
MTBE (Methyl-t-butyl ether) m-Xylene
o-Xylene p-Xylene
Toluene Total Xylenes

Method: 8081B

Matrix Type: NPW/SCM

4,4'-DDD 4,4'-DDE
4,4'-DDT Aldrin
alpha-BHC alpha-Chlordane
beta-BHC Chlordane - not otherwise specified
delta-BHC Dieldrin
Endosulfan I Endosulfan II
Endosulfan sulfate Endrin
Endrin aldehyde Endrin ketone
gamma-BHC (Lindane) gamma-Chlordane
Heptachlor Heptachlor epoxide

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FOT Name: Solid and Chemical Materials, Organic

Method: 8081B

Matrix Type: NPW/SCM

Isodrin

Methoxychlor

Toxaphene

Method: 8082

Matrix Type: NPW/SCM

PCB-1016

PCB-1221

PCB-1232

PCB-1242

PCB-1248

PCB-1254

PCB-1260

Method: 8082A

Matrix Type: NPW/SCM

PCB-1016

PCB-1221

PCB-1232

PCB-1242

PCB-1248

PCB-1254

PCB-1260

Method: 8260B

Matrix Type: NPW

Propionitrile (Ethyl cyanide)

Matrix Type: NPW/SCM

1,1,1,2-Tetrachloroethane

1,1,1-Trichloroethane

1,1,2,2-Tetrachloroethane

1,1,2-Trichloroethane

1,1-Dichloroethane

1,1-Dichloroethene

1,1-Dichloropropene

1,2,3-Trichlorobenzene

1,2,3-Trichloropropane

1,2,4-Trichlorobenzene

1,2,4-Trimethylbenzene

1,2-Dibromo-3-chloropropane (DBCP)

1,2-Dibromoethane (EDB)

1,2-Dichlorobenzene

1,2-Dichloroethane

1,2-Dichloropropane

1,3,5-Trimethylbenzene

1,3-Dichlorobenzene

1,3-Dichloropropane

1,4-Dichlorobenzene

1,4-Dioxane

2,2-Dichloropropane

2-Butanone (Methyl ethyl ketone, MEK)

2-Chloro-1,3-butadiene (Chloroprene)

2-Chloroethyl vinyl ether

2-Chlorotoluene

2-Hexanone

2-Methyl-1-propanol (Isobutyl alcohol)

2-Nitropropane

2-Propanol (Isopropyl alcohol)

4-Chlorotoluene

4-Methyl-2-pentanone (Methyl isobutyl ketone, MIBK)

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FOT Name: Solid and Chemical Materials, Organic

Matrix Type: NPW/SCM

Method: 8260B

- Acetonitrile
- Acetone
- Acrolein (Propenal)
- Acrylonitrile
- Allyl chloride
- Benzene
- Bromobenzene
- Bromochloromethane
- Bromodichloromethane
- Bromoform
- Bromomethane
- Carbon disulfide
- Carbon tetrachloride
- Chlorobenzene
- Chlorodibromomethane (Dibromochloromethane)
- Chloroethane
- Chloroform
- Chloromethane
- Chloroprene
- cis-1,2-Dichloroethene
- cis-1,3-Dichloropropene
- cis-1,4-Dichloro-2-butene
- Dibromomethane
- Dichlorodifluoromethane
- Dichloromethane (Methylene chloride)
- Diethyl ether
- Ethanol
- Ethyl acetate
- Ethyl methacrylate
- Ethylbenzene
- Hexachlorobutadiene
- Isopropylbenzene
- Methacrylonitrile
- Methyl ethyl ketone
- Methyl iodide (Iodmethane)
- Methyl isobutyl ketone
- Methyl methacrylate
- Methyl-t-butyl ether
- m-Xylene
- Naphthalene
- n-Butylbenzene
- n-Propylbenzene
- o-Xylene
- p-Isopropyltoluene
- p-Xylene
- sec-Butylbenzene
- Styrene
- t-Butyl alcohol
- tert-Butylbenzene
- Tetrachloroethene
- Toluene
- trans-1,2-Dichloroethene
- trans-1,3-Dichloropropene
- trans-1,4-Dichloro-2-butene
- Trichloroethene
- Trichlorofluoromethane
- Vinyl acetate
- Vinyl chloride
- Xylenes (Total)

Method: 8270C

Matrix Type: NPW/SCM

- 1,2,4-Trichlorobenzene
- 1,2-Dichlorobenzene
- 1,2-Diphenylhydrazine
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 2,4,5-Trichlorophenol

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FOT Name: Solid and Chemical Materials, Organic

Method: 8270C

Matrix Type: NPW/SCM

- 2,4-Dichlorophenol
- 2,4-Dinitrophenol
- 2,6-Dinitrotoluene (2,6-DNT)
- 2-Chlorophenol
- 2-Methylphenol (o-Cresol)
- 2-Nitrophenol
- 3-Methylphenol (m-Cresol)
- 4,6-Dinitro-2-methylphenol
- 4-Chloro-3-methylphenol
- 4-Chlorophenyl phenyl ether
- 4-Nitroaniline
- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzyl alcohol
- Bis(2-chloroethyl) ether
- Bis(2-ethylhexyl) phthalate
- Chrysene
- Dibenzofuran
- Dimethyl phthalate
- Di-n-octyl phthalate
- Fluorene
- Hexachlorobutadiene
- Hexachloroethane
- Isophorone
- Nitrobenzene
- N-Nitrosodi-n-propylamine
- Pentachlorophenol
- Phenol
- Pyridine
- 2,4,6-Trichlorophenol
- 2,4-Dimethylphenol
- 2,4-Dinitrotoluene (2,4-DNT)
- 2-Chloronaphthalene
- 2-Methylnaphthalene
- 2-Nitroaniline
- 3,3'-Dichlorobenzidine
- 3-Nitroaniline
- 4-Bromophenyl phenyl ether
- 4-Chloroaniline
- 4-Methylphenol (p-Cresol)
- 4-Nitrophenol
- Acenaphthylene
- Benzidine
- Benzo(a)pyrene
- Benzo(g,h,i)perlyene
- Benzoic acid
- Bis(2-chloroethoxy) methane
- Bis(2-chloroisopropyl) ether
- Butyl benzyl phthalate
- Dibenz(a,h)anthracene
- Diethyl phthalate
- Di-n-butyl phthalate
- Fluoranthene
- Hexachlorobenzene
- Hexachlorocyclopentadiene
- Indeno(1,2,3-cd) pyrene
- Naphthalene
- N-Nitrosodimethylamine
- N-Nitrosodiphenylamine
- Phenanthrene
- Pyrene

Method: 8270D

Matrix Type: NPW/SCM

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FOT Name: Solid and Chemical Materials, Organic

Method: 8270D

Matrix Type: NPW/SCM

1,2-Dichlorobenzene
1,3-Dichlorobenzene
1-Methylnaphthalene
2,4,6-Trichlorophenol
2,4-Dimethylphenol
2,4-Dinitrotoluene (2,4-DNT)
2-Chloronaphthalene
2-Methylnaphthalene
2-Nitroaniline
3,3'-Dichlorobenzidine
3-Nitroaniline
4-Bromophenyl phenyl ether
4-Chloroaniline
4-Methylphenol (p-Cresol)
4-Nitrophenol
Acenaphthylene
Benzidine
Benzo(a)pyrene
Benzo(g,h,i)perlyene
Benzoic acid
Bis(2-chloroethoxy) methane
Bis(2-chloroisopropyl) ether
Carbazole
Dibenz(a,h)anthracene
Diethyl phthalate
Di-n-butyl phthalate
Fluoranthene
Hexachlorobenzene
Hexachlorocyclopentadiene
Indeno(1,2,3-cd) pyrene
Naphthalene
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
Phenanthrene
1,2,4-Trichlorobenzene
1,2-Diphenylhydrazine
1,4-Dichlorobenzene
2,4,5-Trichlorophenol
2,4-Dichlorophenol
2,4-Dinitrophenol
2,6-Dinitrotoluene (2,6-DNT)
2-Chlorophenol
2-Methylphenol (o-Cresol)
2-Nitrophenol
3-Methylphenol (m-Cresol)
4,6-Dinitro-2-methylphenol
4-Chloro-3-methylphenol
4-Chlorophenyl phenyl ether
4-Nitroaniline
Acenaphthene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzyl alcohol
Bis(2-chloroethyl) ether
Butyl benzyl phthalate
Chrysene
Dibenzofuran
Dimethyl phthalate
Di-n-octyl phthalate
Fluorene
Hexachlorobutadiene
Hexachloroethane
Isophorone
Nitrobenzene
N-Nitrosodi-n-propylamine
Pentachlorophenol
Phenol

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FOT Name: Solid and Chemical Materials, Organic

Matrix Type: NPW/SCM

Pyridine

Method: 8260B

Matrix Type: NPW/SCM

1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF)
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Total Heptachlorodibenzo-p-dioxin (HpCDD)
Total Hexachlorodibenzo-p-dioxin (HxCDD)
Total Pentachlorodibenzo-p-dioxin (PeCDD)
Total Tetrachlorodibenzo-p-dioxin (TCDD)

Method: 8290A

Matrix Type: NPW/SCM

1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Total Heptachlorodibenzo-p-dioxin (HpCDD)
Total Hexachlorodibenzo-p-dioxin (HxCDD)
Total Pentachlorodibenzo-p-dioxin (PeCDD)
Total Tetrachlorodibenzo-p-dioxin (TCDD)

Method: 8270D

Pyrene

1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin (OCDD)
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)
2,3,7,8-Tetrachlorodibenzofuran (TCDF)
Total Heptachlorodibenzofuran (HpCDF)
Total Hexachlorodibenzofuran (HxCDF)
Total Pentachlorodibenzofuran (PeCDF)
Total Tetrachlorodibenzofuran (TCDF)

1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)
2,3,7,8-Tetrachlorodibenzofuran (TCDF)
Total Heptachlorodibenzofuran (HpCDF)
Total Hexachlorodibenzofuran (HxCDF)
Total Pentachlorodibenzofuran (PeCDF)
Total Tetrachlorodibenzofuran (TCDF)

Appendix B

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APPENDIX B
QUALITY ASSURANCE/QUALITY CONTROL MEASURES – GEOPHYSICAL SURVEY

Quality Assurance Project Plan
Site Investigation
BP Products North America, Inc. Site #5482

Quality Assurance/Quality Control Measures

Geophysical Survey

Equipment

Radio Frequency Detection: RD-7000+

Ground Penetrating Radar: GSSI SIR-3000 system with 400 MHz antenna (model 5103A)

Electromagnetic Profiler: GSSI IMP-400

Equipment Procedures

Radio Frequency Detection: Pipe/cable locator. With accessible metallic pipes/tracer wires, attach the transmitter, send a tracer signal, follow with the receiver and mark. With receiver, also do a passive sweep for electric fields (from live power) or communications signals.

Ground Penetrating Radar: Clear the area to be scanned. If necessary, mark individual transects to be scanned. Scan along a transect, data is shown in real-time. If an anomaly is visible, back up and mark it out. Continue until the area has been scanned in both directions and diagonals as necessary.

Electromagnetic Profiler: Initialize equipment, and start in one corner of the area. Start data collection, and walk slowly in ~5' spaced gridlines, one direction. Readings are coordinated with integrated GPS logger. Export data to computer, process with mapping software to produce contour maps of electrical properties, highlighting any significant anomalies and field mark anomalies.

Training

All operators have been through training courses provided by the equipment manufacturers. Following those, they apprentice with us for approximately 3 months and pass evaluations before being released into the field. At least 1-2 times per year, they go through refresher courses or equipment-specific advanced training.

Calibration

The Ground Penetrating Radar and Electromagnetic Profiler re-calibrate every time they are initialized. They function by detecting the differences or changes in physical properties. The absolute values will vary from site to site, or even at the same site through the year with changing conditions. These instruments are not so much concerned with the absolute values but to changes in values - drastic increases in conductivity (metal objects) or decreases in density (voids), for example.

The readout is adjusted based on the initial calibration scan to best display these kinds of changes. They can be re-initialized as necessary, for example if half of the scanning is over grass and half over asphalt.

Inspection and Maintenance

As for in-field inspections, all the equipment is electronics/computers, without a lot of moving or mechanical parts. The most important inspection is just viewing the quality of data. If the results seem to be poor, tests can be conducted in very easy areas (such as finding USTs at a gas station) to determine if the equipment is functioning properly.

All repairs to the electronics are conducted by the manufacturer.

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APPENDIX C
STANDARD OPERATING PROCEDURES AND FIELD FORMS

Quality Assurance Project Plan
Site Investigation
BP Products North America Site, Inc. Site #5482

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for collecting soil samples when drilling with hollow-stem augers, direct push, and hand auger methods. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure provides descriptions of equipment, field procedures, sample containers, decontamination, documentation, decontamination, storage, holding times, and field quality assurance (QA) and quality control (QC) procedures necessary to collect soil samples.

While the Project Quality Assurance Project Plan (QAPP) is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result, such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
USCS	Unified Soil Classification System
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

3.0 HEALTH AND SAFETY CONSIDERATIONS

Refer to the site-specific Health and Safety Plan (HASP) for health and safety considerations applicable to soil sampling.

Many hazards should be considered during the soil sampling activities, careful consideration of these hazards by the project team is essential. Some of the hazards include the following:

- Proper utility clearance must be performed in accordance with the Pre-Drilling/Excavation Checklist and Utility Clearance Log. There must be a minimum clearance of five (5) feet in addition to the diameter of the drilling augers. Client-specific requirements may be more restrictive.
- Traffic control may be required depending on the proximity of soil sampling activities to the roadway. Traffic control plans should be carefully evaluated to adequately delineate the work zone and provide the necessary safety factors.
- Personal protective equipment (PPE) including hard hats, high visibility traffic vest, gloves, hip boots or chest waders and other appropriate clothing;
- Heat and cold stress;
- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.
- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.
- Decontamination of equipment and personnel must be properly designed and constructed to be sure that contamination is kept within the boundaries of the exclusion zone;
- Noise and proper use of hearing protection devices such as ear plugs and muffs.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractors and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Soil sampling shall be done by personnel familiar with the common sources of random and systematic error so appropriate decisions can be made in the field. Some of the common phenomena which may degrade the sample quality collected from the well point are listed below.

- **Volatilization.** Volatilization occurs when the sample is in contact with air for an extended time. Typically volatilization occurs if the sample undergoes excessive disturbance during sampling or if air pockets exist at the top of the container. Limiting disturbance during sampling, filling sample containers in order of volatility, and tight capping of bottles immediately after filling will minimize these errors.

- **Adsorption/desorption.** This is the gain or loss of chemicals through exchange across surfaces. Adsorption may occur when the sample comes in contact with large surface areas such as the sampling container. Thorough decontamination of sample collection containers/monitoring equipment probes along with expedient transfer from the sample container to the laboratory container minimizes sorption effects.

- **Chemical reaction.** Dissolved chemical constituents may change due to reactions such as oxidation, hydrolysis, precipitation, etc. Proper preservation and adherence to holding times minimize these reactions.

- **Sample contamination.** Sample contamination is the most common source of errors and can result from several factors, including incomplete decontamination, contact with other samples, and contact with the atmosphere. Careful attention to decontamination, handling, and container sealing minimizes sample contamination.

5.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete soil sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the soil sampling will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager or Project QA/QC Officer.

6.0 TRAINING AND QUALIFICATIONS

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform soil sampling will be required to have:

- Read this SOP.

- Read project-specific QAPP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the Occupational Safety and Health Administration (OSHA) 40-hour training course, and/or annual 8-hour refresher course, as appropriate.
- Coordinated any proposed sampling activites with the laboratory to ensure proper sampling procedures.
- Previously performed soil sampling activities generally consistent with those described in this SOP.

Stantec employees who do not have previous experience with soil sampling will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures.

7.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform soil sampling:

- Auger rig or direct-push unit with appropriate equipment for sampling, or hand auger.
- Continuous soil sampler (2-½-inch x 18-inch or 2-foot split-spoon sample tube) or direct-push clear acetate or polyvinyl chloride PVC tube (typically 4-foot long).
- Photoionization detector (PID) or other air monitoring instrumentation as required by the HASP.
- 4-mil-thick plastic sheeting or aluminum foil.
- Tape measure.
- Unified Soil Classification System (USCS) based on the Visual-Manual Procedures in ASTM Standards D 2487-00 and D 2488-00.
- 5035 sample containers with lids.
- Terra-cores™ or similar coring sampling device, if required.
- Sample labels.
- Stainless steel trowels, putty knives or similar soil working tool.
- Penetrometer (if available).
- Waterproof marking pens, such as the Staedtler Lumocolor.
- Coolers (with ice) for sample storage and shipment.
- Sample data forms/clip board.

- Decontamination supplies (Alconox™ [or similar detergent], brush, bucket).
- Nitrile gloves, or other specified chemical resistant gloves.
- Work gloves.
- Camera and film or disks.
- Blank soil borehole logs or a field-logging PDA.
- Personal safety gear (hard hat, steel-toed boots, ear plugs, safety glasses, etc.).

8.0 METHODS

8.1 Hollow-Stem Auger/Direct Push Sampling

Make sure that all equipment and meters have been calibrated to the equipment specifications and the results have been recorded in the field log.

The top five (5) feet of the boreholes will be cleared via air knife, vacuum excavation, ground penetrating radar, hand auger, tile probe or some combination of these methods.

Shallow soil boreholes are typically drilled with hollow-stem augers or geoprobe and sampled at the intervals specified in the work plans. Sampling shall be done in advance of the lead auger to minimize cross-contamination. Samples for laboratory analysis shall be taken with a continuous soil sampler. Standard blow counts shall be recorded for driving the sampler 6 and 12 inches (ASTM Method D 1586-99) if sampler is hammer driven.

Upon retrieval of the sample, the sample will placed on a clean surface (or lined with disposable aluminum foil or plastic sheeting) and will be screened with a PID for locating potential elevated PID readings. If applicable, a representative grab sample will be collected along with a headspace sample and placed into the appropriately labeled sample container. The sample containers shall be placed in self-sealing plastic or bubble bags in a cooler with ice or frozen ice packs for storage until they are delivered to the analytical laboratory.

The following method is to be used for headspace screening:

- The portion (for headspace screening) should be placed into an appropriately sized re-sealable Ziploc® or equivalent bag;
- Seal and label the bag with the borehole identification and the depth of the sample;
- Allow the bag to equilibrate for approximately ten (10) minutes; and
- Insert the probe tip of the PID into the bag. Obtain a measurement using the PID.

The remainder of the sample shall be logged in accordance with the USCS and recorded on the boring logs according to the following procedure:

1. As much information as possible is to be shown in the heading of each log. This includes, but is not limited to:

   - Project name and project identification number;
   - Identification of borehole;
   - Name of drilling company;
   - Make, model, type, and size of drilling and sampling equipment used;
   - Date and time of start and end of drilling
   - Name of geologist(s) logging boring;
   - End of boring depth; and,
   - Depth to water (if encountered).

2. Each log is to begin with a description of the surface, (i.e., native, paved with asphalt, paved with concrete, and such). If any concrete is cut to open the hole, the thickness will be noted.

3. Every foot will be accounted for, with no gaps. If an interval is not sampled it will be noted. If an attempt is made to sample an interval, but there is no recovery, it will be noted.

4. Complete construction details are to be detailed for each well on a standard well construction form. Construction details should include:

   - A description of the type and length of casing i.e., 20' of 2" inner diameter (ID) Schedule 40 PVC casing;
   - Length and depths of the top and bottom of the screened interval;
   - Screen slot size;
   - Depths of the top and bottom of the filter pack;
   - Filter pack materials and sand size;
   - Depths and types of bentonite seals;
   - Detail of the use of grout; and,
   - Detail of the surface completion (i.e., stick up, flush-mounted).

5. The number of bags of sand, bentonite, and grout used will be counted. These numbers will be compared daily with the driller's daily report.

Soil cuttings will be stockpiled on 4-mil thick plastic sheeting or drummed. The cuttings and other investigation-derived waste will be managed in accordance with the work plan or client-specific directives.

When sampling for volatile organic compounds (VOCs), use USEPA Method 5035. Method 5035 requires ample preservation in the field at the point of collection. The preservative used for the low concentration soil method (0.5 to 200 µg/kg) is sodium bisulfate and the preservative used for the medium/high concentration soil method (>200 µg/kg) is methanol. This field collection and preservation procedure is intended to

prevent loss of VOCs during sample transport, handling, and analysis. The holding time for VOC analysis is 14 days.

1. Use the lab provided plunger style sampler (T-handle, syringe with tool, or terra-core™ sampler) to collect a 5g soil sample.
2. Unscrew the lid of the lab provided pre-preserved sodium bisulfate volatile organic analysis (VOA) vials and inject the 5g soil sample.
3. Tightly seal the VOA vial.
4. Repeat this step with the second sodium bisulfate VOA vial.
5. Then, repeat with the methanol preserved VOA vial.
6. Collect a soil sample in the 4-ounce wide mouth glass jar provided by the lab.
7. Make sure sample containers are labeled and bagged in plastic or bubble bags.
8. Ice the samples.

8.2 Hand Auger Sampling

Shallow soil boreholes less than five (5) feet in depth can be collected using a hand auger. The auger will be advanced until the desired sampling depth is reached. The auger will be removed from the boring, the sample will be extracted from the hand auger and field screened (as appropriate), and representative grab samples will be collected and placed into the appropriate labeled sample container. Decontamination of the auger and extensions will occur after each sample.

Boreholes will be abandoned by backfilling with bentonite chips and hydrating with potable water.

8.3 Excavation

Excavations and test pits will be excavated using a backhoe provided by the subcontractor. The dimensions of individual excavations will vary depending on the strength and stability of the trench walls and the specific purpose of the trench. Excavations greater than four (4) feet deep will not be entered by any personnel unless shoring is performed or the sides are stepped back to the proper angle per OSHA requirements.

When starting an excavation, the backhoe operator will first remove the topsoil or cover (if any) and place it in a discrete mound at least five (5) feet from the edge of the excavation. The excavation will be continued in approximately 6-inch cuts with the backhoe using a horizontal scraping motion rather than a vertical scooping motion. If a visibly-stained or otherwise chemically-affected soil interval is encountered, the affected excavated soils will be placed on 4-mil thick plastic sheeting.

8.3.1 Excavation Sampling

Samples will be collected from the backhoe bucket using a stainless steel trowel or similar. The top layer of soil will be removed prior to collecting the sample. The soil will then be placed in the appropriately labeled sample container and placed inside a chilled cooler.

8.3.2 Excavation Backfilling

The soils will be replaced in the excavation at their original depths to the extent practicable so that the soil from the bottom of the trench will be placed on the bottom, and the topsoil will be replaced on the top. The backhoe will be used to backfill and compact the excavation.

Upon completion and subsequent backfilling of each excavation, four corners will be marked with a wooden stake for surveying. If appropriate, a fifth stake will be placed above the location where a soil sample was collected. The points may be surveyed, as needed.

8.4 Decontamination Methods

8.4.1 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed to be sure that the solutions used are appropriate for the chemicals of interest.
- Ensure that the decontamination area is properly constructed to keep contamination within the contamination reduction and exclusion zones.
- Ensure that the decontamination area is properly constructed to contain the rinse solutions and solids.
- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Smaller equipment that will not be damaged by water will be placed in a wash bucket containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Smaller equipment will be rinsed in water. Change rinse and detergent waters between boreholes, as needed.
- For larger drilling equipment the soil and/or other material will be scraped off with a flat-bladed scraper, and placed within a deconcontamination (decon) pad. The decon pad will be constructed in a predetermined location, and equipment shall be cleaned with a pressure washer using potable water. Care will be taken to adequately clean the insides of the hollow-stem augers, and cutter heads.
- Equipment that may be damaged by water will be carefully wiped clean using a

sponge and detergent water and rinsed in or wiped down with distilled water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with potentially contaminated soil.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it will be stored in the designated secure, clean area.

8.4.2 Excavation Decontamination

Decontamination protocols must be carefully designed and constructed to deal with the chemicals of interest and ensure that the rinse solutions and solids are contained within the contamination reduction zone.

The backhoe bucket will be decontaminated prior to excavating each excavation. The entire backhoe, bucket, and tires will be decontaminated at the conclusion of the trenching operation. Decontamination will involve using a steam cleaner with an Alconox™ solution or pressure washer and rinsing using a steam cleaner or pressure washer with potable water. Backhoe decontamination will take place at the decontamination area located adjacent to the maintenance building or at another appropriate location.

The sampling equipment will be decontaminated prior to collecting each sample. Decontamination will consist of washing the equipment with a scrub brush in a bucket with an Alconox™ solution (or equivalent) and rinsing the equipment in a bucket filled with tap water. The date and time of decontamination of the backhoe and sampling equipment will be recorded in the field book and/or data collection forms.

8.5 Sample Containers, Storage, and Holding Times

Refer to the Project Sampling and Analysis Plan (SAP) for project specific instructions on proper containers, storage of samples and allowable holding times.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the QAPP and SAP for specific quality control checks and acceptance criteria.

10.0 DOCUMENTATION

A borehole log will be completed for each hollow-stem auger or direct-push borehole. The field notebook and/or data collection forms will contain the following information:

- Project name and number.
- Drilling company's name.
- Date drilling started and finished.
- Type of auger and size (ID & OD).

- Type of equipment for air monitoring (PID or FID).
- Air monitoring calibration and measurements.
- Well completion and graphic log.
- Driller's name.
- Geologist's or engineer's name.
- Type of drill rig.
- Borehole number.
- Surface elevation (if available).
- Stratigraphic description with depth.
- Classification of the soils according to the USCS.
- Water levels and light non-aqueous phase liquid levels, if applicable.
- Drilling observations.
- Map of borehole or monitoring well location.

In addition, proper documentation will include observance of the chain of custody procedures as described in the Project QAPP and SAP.

Additional information regarding field documentation for borehole logging for fine- and coarse-grained soils and rocks is provided in Stantec checklists ERPA-603 through ERPA-605.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for decontamination procedures. The ultimate goal of the decontamination procedure is to prevent cross-contamination between samples and sample areas and to protect workers from hazardous materials.

This procedure gives descriptions of equipment and field procedures necessary to perform decontamination.

This procedure may apply to all sampling by Stantec personnel or their subcontractors by the aforementioned sampling methods.

It must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance and sufficiently documented so that the reason for the deviation can be clearly articulated to our clients and regulators, as necessary. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity.

2.0 DEFINITIONS

FSP	Field Sampling Plan
HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review may be performed by modifying a generic or an existing Job Safety Analysis in the HASP. Following is a short list of the items for consideration. Careful review of these items and other site-specific conditions by the project team is essential.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.
- Personal protective equipment, including hard hats, high-visibility traffic vest, gloves, appropriate clothing.
- Heat and cold stress.

- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.

- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.

- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.

- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.

- The exclusion and contaminant reduction zones must be properly designed and constructed so that contamination from decontamination activities of equipment and personnel is kept within this area.

- Noise and proper use of hearing protection devices such as ear plugs and muffs.

- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractor and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete decontamination activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the decontamination tasks will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to oversee decontamination will be required to have:

- Read this SOP;
- Read project-specific QAPP;
- Indicated to the Task Leader that all procedures contained in this SOP are understood;
- Completed the OSHA 40-hour training course and 8-hour refresher course, as appropriate; and,
- Previously performed decontamination activities generally consistent with those described in this SOP.

5.0 TRAINING/QUALIFICATIONS

Stantec employees who do not have previous experience with decontamination will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures.

6.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform decontamination:

- Paper towels;
- Aluminum foil;
- Trash bags;
- Non-phosphate detergent (e.g., Alconox™);
- Distilled or deionized water (where available);
- Spray bottles;
- Cleaning brushes;
- 5-gallon buckets, purge tank, trailer, drums and drum labels or waste containers;
- Nitrile gloves, or other specified chemical resistant gloves;
- Work gloves; and,
- Personal protective equipment (hard hat, steel-toed boots, etc.).

7.0 DECONTAMINATION METHODS

Reusable field instrumentation and sampling equipment will be decontaminated prior to their first use, and between each well/sampling location in which they are used. Two types of decontamination procedures will be employed, depending on the level of visual or otherwise known contamination to which the instrumentation is exposed. Pre-use decontamination will follow the first decontamination protocol listed below.
Reusable instrumentation/equipment that has signs of visible NAPL or has potentially come in contact with NAPL-impacted material will be decontaminated in the following manner:

1. The instrumentation/equipment will be thoroughly rinsed with tap water to remove sediment and debris, after caked on material has been physically removed.

2. The instrumentation and sampling equipment will be thoroughly washed with a mixture comprised of approximately two (2) tablespoons of Alconox™ (or similar low phosphate cleaning agent) per 1-gallon of de-ionized water. A stiff bristle scrub brush will be used if necessary to provide thorough cleaning.

3. The instrumentation/equipment will be triple-rinsed with unused distilled or de-ionized water where available.

The effectiveness of the above decontamination procedures will be demonstrated through the periodic use of equipment blanks. A more detailed discussion of the proposed use of equipment blanks is provided in the FSP

Drill rigs or Geoprobes used on site will be thoroughly decontaminated prior to their arrival at the site and prior to initiation of any drilling activities. The rig and its equipment will be thoroughly examined to ensure that there are no significant fuel, hydraulic fluid, transmission oil, and/or motor oil leaks that could create a condition not previously in existence or exacerbate an existing condition.

Once the rig and its equipment have been thoroughly cleaned and inspected, subsequent decontamination efforts will focus only on those pieces of equipment which actually come into contact with soils or groundwater. No petroleum hydrocarbon based lubricants will be allowed on the drill stems or associated connections. Both the initial comprehensive cleaning of the rig and subsequent decontamination procedures will be performed using either steam-cleaning equipment or high pressure hot water/detergent wash. In addition, casing centralizers and casing handling equipment, if used, will be cleaned prior to use in the construction of monitoring wells.

Decontamination wash solutions and rinsate will be collected and containerized in 5-gallon buckets, 55-gallon drums, or poly tanks. The collected rinsate will be disposed of appropriately.

8.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

9.0 DOCUMENTATION

A record will be maintained during the purging procedure that will contain at a minimum:

- Project name and number;
- Date, personnel;
- Decontamination procedures;
- Volume of rinsate fluid generated during decontamination; and,
- Disposal method of decontamination water.

The data shall be recorded on a log form or in field logs.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for installing monitoring wells using hollow-stem augers. The following items will be discussed in detail in the Methods section of this SOP:

- Well material specifications
- Well installation
- Well development
- Surveying well casings

The step-by-step procedures are described in sufficient detail to allow field personnel to install monitoring wells of sufficient integrity.

While the QAPP is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

FSP	Field Sampling Plan
HASP	Health and Safety Plan
LPG	Licensed Professional Geologist
OSHA	Occupational Safety and Health Administration
PE	Professional Engineer
PG	Professional Geologist
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RG	Registered Geologist
SOP	Standard Operating Procedure
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Personal protective equipment specified in the Health and Safety Plan will be donned before proceeding with sampling or well installation activities. Organic vapor readings measured at intervals in the breathing zone will be used to determine if respirators are needed throughout the sampling and well installation procedures. The organic vapor readings will be recorded in the field notebook and/or on data collection forms. Refer to the site-specific HASP for further health and safety considerations applicable to installing monitoring wells with hollow-stem augers.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.

- Personal protective equipment, including hard hats, high-visibility traffic vest, gloves, appropriate clothing.

- Heat and cold stress.

- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.

- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be avoided.

- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.

- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.

- Noise and proper use of hearing protection devices such as ear plugs and/or muffs.

- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

4.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to direct and observe the installation of monitoring wells by the subcontractor and to collect soil samples. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the collection of soil and ground water samples with hollow-stem augers will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform monitoring well installation will be required to have:

- Read this SOP;
- Indicated to the Task Leader that all procedures contained in this SOP are understood;
- Completed the OSHA 40-hour training course, and/or annual 8-hour refresher course, as appropriate; and
- Previously directed monitoring well installations in a manner generally consistent with the procedures described in this SOP.

Stantec employees who do not have previous experience installing monitoring wells will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures. A qualified certified LPG, PG, RG, or PE will maintain close supervision of the project progress, results, and interpretations. The Project Manager shall document personnel qualifications related to this procedure in the project QA files.

5.0 TRAINING/QUALIFICATIONS

Stantec employees who do not have previous experience installing monitoring wells will be trained on site by a qualified Stantec employee and supervised directly by that employee until they have demonstrated an ability to perform the procedures.

6.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform monitoring well installation using hollow-stem augers. Please note that some of this material will be supplied by the monitoring well installation subcontractor.

- well casing and well screen
- bentonite pellets or chips
- filter sand
- cement and powdered bentonite for grouting
- protective well casing with locking cap
- steel guard posts
- submersible pump or bailer with polypropylene twine for well development
- location map
- auger rig

- weighted tape measure
- water level probe
- flame ionization detector (fid) or photo ionization detector (PID)
- field notebook and data collection forms
- decontamination supplies
- nitrile gloves
- camera and film or disks
- personal safety gear

7.0 METHODS

7.1 Well Materials Specifications

Well Casing
Well casing will consist of Schedule 40 PVC, 2-inch diameter, threaded, flush-joint pipe. Well casing will be provided with a vented cap of similar diameter. No solvents, cements, or adhesive tapes may be used to connect sections of well casing.

Well Screen
Well screen will consist of threaded, flush-joint pipe with factory machine slots or wire-wrapped design screen 10 millimeters in size. The slot size will be small enough to retain approximately 80 to 90 percent of the filter pack material. Well screen length will be 10 feet long. Well screens will be provided with bottom sumps that range from 0.5 to 2 feet in length. No solvents, cements, or adhesive tapes may be used to connect sections of screen.

Filter Pack
The annular space between the well screen and the borehole wall will be backfilled with clean, washed, well-graded, silica sand compatible in size with the formation. The appropriate filter pack gradation will be determined for each well from aquifer material sieve analysis results.

Bentonite Seal
The bentonite seal will consist of a layer of bentonite pellets, chips, or slurry.

Cement/Bentonite Grout
Grout used for sealing a well will consist of Portland cement, pure bentonite powder, and potable water. Approximate constituent proportions are as follows:

- 94 pounds (one bag) Portland cement

- 2 pounds of bentonite powder
- 10 gallons of potable water

The grout will be prepared by first thoroughly mixing the bentonite and water, and then mixing in the Portland cement.

The porous nature of the unsaturated fill present may make it difficult to keep grout in the borehole. If this occurs, the grout mixture will be thickened by changing the constituent proportions to 2 to 3 pounds of powdered bentonite prehydrated in 7 to 8 gallons of water per sack of cement. The quantities of materials used in the preparation of the grout and the total quantity of grout used will be recorded in the field notebook and/or on data collection forms.

Protective Steel Casing
A minimum 8-inch-ID, 5-foot-long, protective steel casing with a hinged or removable lockable steel cap shall be installed over the monitoring well casing that projects above ground surface.

Concrete Pad
Concrete used for completion at grade will be Sakrete, Quikrete, or equivalent, and will not be placed prior to 24 hours after setting the protective steel casing in the cement/bentonite grout.

Steel Guard Posts
If necessary, 2-inch-diameter, 5-foot-long steel posts may be installed to provide extra well head protection.

7.2 Well Installation

The following procedures will be used for well installation using hollow-stem augers:

- If necessary, overdrill well depth by approximately five (5) feet to compensate for heaving sands.
- Measure total depth of completed boring using a weighted tape.
- Remove temporary plug from base of lead auger or remove center bit (depending on which method is used).
- It may be necessary to fill the augers with potable water before the center bit is removed in order to achieve the desired screen interval. The column of water inside the augers will prevent sand from heaving into the auger. A sample of the potable water will be collected for chemical analysis, and the volume of water placed into the borehole recorded on the boring log or field log book.
- Re-measure depth of well.

- Calculate volumes of filter pack, bentonite pellets, and grout required, based on boring and well dimensions.

- Calculate measurement of assembled well screen, sump, and riser pipe to nearest 0.1 foot.

- If boring did not heave to raise total depth to desired well screen depth, place a layer of filter sand or bentonite pellets or chips at the bottom of the hole. Filter sand must be added incrementally, while withdrawing the auger. If bentonite is used, it will be added gradually to prevent bridging. Bentonite addition will stop when its level has reached approximately one (1) foot below the desired base of the screen end cap. The bentonite plug will be hydrated and approximately one (1) foot of filter sand will be poured downhole on top of the bentonite, to raise the bottom of the hole to the desired level.

- Lower the well casing assembly through the hollow portion of the augers until the casing is resting at the bottom of the boring. The casing will extend from the top of the well screen to approximately two (2) feet above ground surface unless a subgrade completion is necessary.

- Record top of casing level and calculate level of screen interval.

- Withdraw the augers at a maximum of 5-foot increments while adding filter pack sand. The filter pack will extend from approximately one (1) foot below the base of the well screen and extend at least one (1) foot but not more than two (2) feet above the top of the well screen.

- Repeated depth soundings using a weighted tape on top of the sand pack shall be taken to monitor the level of the sand and detect any bridging of sand. The top of the well casing shall also be monitored to detect any movement (up or down) due to settlement of filter or auger removal.

- Sufficient time shall be allowed for the filter sand to settle before measuring the sand level or continuing to withdraw the augers. The screen and casing should always be protected from the formation soils by the augers or the filter pack material (e.g., maintain sand level inside of augers at all times).

- The screen will be surged and the casing will be moved gently back and forth during placement of the filter pack to facilitate the settling of the filter pack sand.

- Install a 3- to 5-foot thick bentonite seal above the filter pack. If pellets or chips are used, they will be added gradually to avoid bridging. Repeated depth soundings will be taken using a weighted tape to ascertain the top of the bentonite seal. The seal will be allowed to hydrate for approximately 30 minutes before proceeding with the grouting operation.

- While raising the auger in incremental intervals (to prevent contact of casing with formation), grout the remaining annulus from the top of the bentonite seal to the

ground surface (except for subgrade completions) with the cement/bentonite grout specified in the FSP. The grout will be poured into the annulus, or pumped through a tremie pipe if the depth in the annular space is greater than 15 feet. Grouting will cease when the annulus is completely filled. For subgrade completions, grouting will cease when the grout level has risen to within approximately two (2) feet of the ground surface.

- Before the grout sets, the protective steel casing will be centered on the well casing and inserted into the grouted annulus (if the well is completed above grade). A 2-inch deep temporary spacer shall be placed between the PVC well cap and the bottom of the protective casing cover prior to installation to keep the protective cover from settling onto the well cap.

- After the casing has set, a drainage hole may or may not be drilled in the protective steel casing approximately two (2) inches above ground surface. The protective casing will be painted with a rust-preventive, conspicuously-colored paint.

- Label well cap with well number, depth, and date.

- At least 24 hours after grouting, install the concrete pad and steel guard posts, if necessary.

- For above grade completion, install a minimum 4-inch thick, 3 feet by 3 feet concrete pad at ground surface around the protective steel casing. Slope the concrete away from the well casing to promote surface drainage away from the well.

- For above-grade completions, where traffic conditions warrant extra protection, three steel posts will be embedded to a depth approximately 1.5 feet below the top of the concrete pad. The posts will be installed in concrete-filled post holes spaced equally around the well at a distance of approximately 1.5 feet from the protective steel casing.

Monitoring well installation information is recorded on the field well completion form (Figure 2).

7.3 Well Development

Well development will proceed after the cement/bentonite grout has set for a minimum of 24 hours. The well will be developed using a submersible pump, airlift equipment, a hand bailer, and/or a surge block. Well development will consist of repeated evacuation, followed by surging until the clarity of the water has stabilized. A minimum of 10 well volumes will be purged and at least three times the volume of any clean water added during drilling will be removed. The well development information will be recorded on a well development form.

7.4 Surveying Well Casings

Stantec field personnel will mark the permanent datum point on newly installed wells by cutting a small notch on the north side of the casing. All future static water elevations will be measured from that point. A surveyor will survey the well casing elevation datum to the nearest 0.01 foot and the x and y coordinates to the nearest 0.1 foot. Ground surface elevation will be surveyed to the nearest 0.1 foot.

8.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

9.0 DOCUMENTATION

A construction diagram will be completed for each monitoring well. The field notebook and/or data collection forms will contain the following information:

- Project name and number
- Drilling company name
- Date drilling started and finished
- Type of auger and size (ID & OD)
- Type of equipment for air monitoring (PID or FID)
- Air monitoring measurements
- Well completion and graphic log
- Driller's name
- Geologist or scientist's name
- Type of drill rig
- Boring number
- Surface elevation (if available)
- Water levels
- Drilling observations
- Map of boring or monitoring well location

Refer to the Quality Assurance Project Plan for a description of documentation procedures.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for collecting low flow groundwater samples. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure gives descriptions of equipment, field procedures, sample containers, decontamination, documentation, storage and holding times, and field QA/QC procedures necessary to collect soil samples.

This procedure may apply to all sampling by Stantec personnel or their subcontractors by the aforementioned sampling methods.

It must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance and sufficiently documented so that the reason for the deviation can be clearly articulated to our clients and regulators, as necessary. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity.

2.0 DEFINITIONS

FSP	Field Sampling Plan
HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review may be performed by modifying a generic or existing Job Safety Analysis in the HASP. There are many items to be considered. Following is a short list of the items for consideration. Careful review of these items and other site-specific conditions by the project team is essential.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.
- Personal protective equipment, including hard hats, high-visibility traffic vest, gloves, appropriate clothing.
- Heat and cold stress.

- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.
- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractors and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete low flow groundwater sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the low flow sampling tasks will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform groundwater sampling will be required to have:

- Read this SOP.
- Read project-specific QAPP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the OSHA 40-hour training course and 8-hour refresher course, as appropriate.
- Previously performed low flow groundwater sampling activities generally consistent

with those described in this SOP.

5.0 TRAINING/QUALIFICATIONS

Stantec employees who do not have previous experience with low flow groundwater sampling will be trained on site by a qualified Stantec employee and supervised directly by that employee until they have demonstrated an ability to perform the procedures.

6.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform low flow groundwater sampling:

- Photoionization detector (PID) or other air monitoring instrumentation as needed.
- Sample containers with lids.
- Sample labels.
- Waterproof marking pens, such as the Staedtler Lumocolor.
- Coolers (with ice) for sample storage and shipment.
- Sample data forms/clip board.
- Decontamination supplies.
- Nitrile gloves, or other specified chemical-resistant gloves.
- Work gloves.
- Camera and film or disks.
- Blank groundwater parameter forms or a field-logging PDA.
- Personal safety gear (hard hat, steel-toed boots, etc.).
- Water level indicator or product-water interface probe.
- Centrifugal pump, bladder pump, Grundfos pump (or equivalent).
- Appropriately sized tubing (Teflon or equivalent).
- YSI 556 meter with flow-through cell (or equivalent).
- Turbidity meter, Hatch ferrous iron test kit (or equivalent) as needed.
- Buckets, drums or other containers for purge water.

7.0 METHODS

7.1 Purging Methods

Wells will be purged and sampled according to the following procedures:

- After the water levels and the depth of the wells have been measured, the monitoring wells will be purged at a low-flow rate using a centrifugal pump, bladder pump, Grundfos pump (or equivalent) and dedicated down-hole tubing while measurements of oxygen reduction potential (ORP), dissolved oxygen (DO), standard conductivity (SC), pH, temperature, ferrous iron and/or turbidity (as needed) are monitored using a YSI 556 meter with flow-through cell, appropriate meters and test kits. (The meters will be checked and calibrated prior to use as specified in the operations manuals.) After purging is initiated, the flow will be adjusted to a rate that results in minimal well draw down.

- The pump intake will be located near the middle of the screened interval of each well. Non-dedicated equipment will be decontaminated appropriately before use at each monitoring well.

- Purge rates for low-flow sampling are typically 0.1 - 0.5 liters per minute (L/min). A higher purge rate may be acceptable but this is based on the site hydrology and must be determined at each well location. At no point should the purge rate cause a change in water level of greater than 0.3 feet.

- When using a bladder pump, the pump should be set so that one pulse delivers the entire 40ml vial amount (not mandatory but "best practice").

- Peristaltic pumps should be used with caution. Usage should be based on the intent of the data. If the data is to be used for comparison to clean up goals or groundwater monitoring termination, then peristaltic pump should not be used.

- The well will be purged until water quality parameters (ORP, DO, SC, pH, temperature, and/or turbidity) have stabilized (generally within 10 percent) for three consecutive measurements taken at 3 to 5 minutes intervals or three (3) complete well volumes have been removed. USEPA recommendations for stability parameters are:

  - ❖ Turbidity - 10 percent
  - ❖ DO - 0.3 mg per Liter
  - ❖ Specific Conductance - 3 percent
  - ❖ Temperature - 3 percent
  - ❖ pH - ±0.1
  - ❖ ORP - ± 10mV

  This information will be recorded in a sampling form or on a field-logging PDA.

- Once the water quality parameters have stabilized, a groundwater sample will be collected in appropriate sample containers, or sampled with the appropriate test kit.
- Documentation of all purge data, including volumes (both of water purged and water sampled), elapsed times, pump-flow rates, water level and geochemical parameter measurements will be recorded on the sampling form.

7.2 Decontamination Methods

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed so that the solutions used are appropriate for the chemicals of concern.
- Personnel will don appropriate safety equipment to reduce personal exposure.
- Equipment that will not be damaged by water will be placed in a wash tub containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Equipment will be rinsed in a second wash tub.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water, and wiped with organic-free deionized water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent possible contamination. Single use equipment and consumables will be discarded in an appropriate manner.

8.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

9.0 DOCUMENTATION

A monitoring well low-flow groundwater sampling log will be completed for each monitoring well. The field notebook and/or data collection forms will contain the following information:

- Project name and number.
- Field staff/sampler's name.
- Date and time sampling started and finished.
- Type of equipment for air monitoring and air monitoring data (if applicable).
- Type, make and model number of low flow and sampling equipment used.
- YSI meter (or equivalent), calibration and measurements.

- Depth to groundwater, well bottom and dense non-aqueous phase liquid levels, if applicable.
- Monitoring well purge volume.
- Surface elevation (if available).
- Flow rates.
- ORP, DO, SC, pH, temperature, ferrous Iron and/or turbidity measurements or results and time.
- Additional sample analytical method or analytes and sample identification.
- Sample collection time.
- Sampler's observations.
- Description of monitoring well condition.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for the sampling of monitoring wells. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure provides descriptions of equipment, field procedures, sample containers, decontamination, documentation, storage, holding times, and field quality assurance/quality control (QA/QC) procedures necessary to collect water samples from groundwater monitoring wells.

This procedure may apply to all groundwater sampling of monitoring wells by Stantec personnel or their subcontractors.

While the QAPP is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result, such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

HASP	Health and Safety Plan
HCL	Hydrochloric Acid
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound

3.0 HEALTH AND SAFETY CONSIDERATIONS

Refer to the site-specific HASP for health and safety considerations applicable to groundwater sampling.

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review can be performed by making our generic Job Safety Analysis site specific in our site-specific Health and Safety Plan. Of course, there are many items that need to be considered. The following is just a short list of the items. Careful consideration of these items by the project team is essential, and the ultimate responsibility of the project manager.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.
- Personal protective equipment (PPE) including high visibility traffic vest, gloves, appropriate clothing.
- Heat and cold stress.
- Biological hazards such as insects and spiders. Therefore appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be avoided.
- Chemical exposure on sites with open contamination. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Use of air monitoring instrumentation will not likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.
- Decontamination of equipment and personnel must be properly designed and constructed to be sure that contamination is kept within the boundaries of the exclusion zone.
- Noise and proper use of hearing protection devices such as ear plugs and/or muffs.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client and emergency responders.
- Ergonomics should be considered when setting up equipment. Ensure that staff does not lift more than 50 lbs. alone.

All of these risks and others must be discussed with our subcontractors, if applicable, and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff actually performing the work. Details of procedures, instrument measurements, and other activities must be recorded in the field log and/or on data collection forms.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Sampling shall be done by personnel familiar with the common sources of random and systematic error so intelligent decisions can be made in the field. Some of the common phenomena which may degrade sample quality are listed below:

- **Volatilization.** This occurs when the sample is in contact with air for an extended time. It is typically a problem when water is either sitting in the well or when air pockets exist at the top of the water container. Prompt sampling after well evacuation, proper sampling order (i.e., fill VOC sample containers first), and tight capping of bottles immediately after filling will minimize these errors.

- **Adsorption/desorption.** This is the gain or loss of chemicals through exchange across surfaces. It may occur when the sample comes in contact with large surface areas such as bailers or tubing. Thorough decontamination of bailers and/or tubing, or using disposible bailers and/or tubing and probes along with expedient sampling after well purging minimizes sorption effects.

- **Chemical reaction.** Dissolved chemical constituents may change due to reactions such as oxidation, hydrolysis, precipitation, etc. Proper preservation and adherence to holding times minimize these reactions.

- **Biodegradation.** Virtually all groundwater contains bacteria, some of which may be capable of altering the composition of contaminants. Proper preservation and adherence to holding time will reduce this effect.

- **Sample contamination.** This is the most common source of errors and can result from several factors, including incomplete decontamination, contact with other samples, and contact with the atmosphere. Careful attention to decontamination, handling, and container sealing minimizes sample contamination.

5.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete water sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the water sampling task will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

6.0 TRAINING/QUALIFICATIONS

Only qualified personnel shall be allowed to perform water sampling. At a minimum, Stantec employees qualified to perform water sampling will be required to have:

- Read this SOP.

- Indicated to the Task Leader that all procedures contained in this SOP are understood.

- Completed the OSHA 40-hour training course and/or 8-hour refresher course, as appropriate.

- Previously performed water sampling in a manner generally consistent with the procedures described in this SOP.

Stantec employees who do not have previous experience sampling ground water will be trained on site by a qualified Stantec employee and supervised directly by that employee until they have demonstrated an ability to perform the procedures.

The Project Manager shall document personnel qualifications related to this procedure in the project QA files.

7.0 REQUIRED MATERIALS

Dedicated evacuation/sampling equipment will be used whenever possible and stored at the well or a designated location on site. Sample bottles for volatile and semivolatile organic compounds, general mineral, and metals samples will be obtained from the analytical laboratory. Extra sample containers will be obtained in case of breakage or other problems. Trip blanks will also be obtained from the analytical laboratory.

A typical well evacuation equipment list:

- Water level probe or fiberglass tape.
- Bailers:
  2-inch-diameter well
  - 1.66-inch O.D. x 3-foot PVC bailer, or
  - 1.66-inch O.D. x 5-foot PVC bailer, or
  - 1.66-inch O.D. x 3-foot disposable polyethylene bailer.
- Pumps:
  - Grundfos, bladder, or peristaltic type submersible pump.
- Teflon-coated bailing wire rope or disposable polyethylene cord.
- Electric generator.
- YSI meter.
- Personal protective equipment, including nitrile (or other material depending upon the nature of the chemicals encountered) or powderless surgical gloves and safety glasses. Tough work gloves may also be required for moving around equipment before or after the sampling itself. Other PPE include traffic vest, steel-toed safety shoes, hearing protection devices, long-sleeved shirt and long pants, and possibly a respirator if there is volatilization of chemicals, etc.
- Groundwater sample collection data forms.
- Photoionization Detector (PID).
- Data recording sheets/electronic storage device (PDA).

- Field notebook.

A typical well sampling equipment list:

- Sampling bailers (double check valve, bottom discharge).
- Teflon-coated bailing wire rope or disposable polypropylene cord.
- Bladder pump Teflon and/or stainless steel construction equipped with Teflon and/or Teflon-lined control and discharge tubing.
- Personal protective equipment, including nitrile (or other material depending upon the nature of the chemicals we expect to encounter) or powderless surgical gloves and safety glasses. Tough work gloves may also be required for moving around equipment before or after the sampling itself. Other PPE include traffic vest, steel-toed safety shoes, hearing protection devices, long-sleeved shirt and long pants, and possibly a respirator if there is volatilization of chemicals, etc.
- Ground Water Sample Collection Data Forms.
- Chain-of-custody forms.
- Labels.
- Cooler.
- Ice or frozen ice packs.
- Field notebook.

Proposed equipment for sample filtration, if filtration is needed:

- Two clean containers, approximately one (1) liter in size
- Organic-free deionized water
- One Peristaltic filtration pump
- In-line plate filter
- Filter membranes–0.45 µ pore size
- A 1:1 nitric acid/purified water solution or 0.1 normal HCL for decontamination of filtering glassware

Equipment used during decontamination:

- Alconox™ detergent (or equivalent) or other solution that will neutralize the chemicals encountered.

- Organic-free deionized water, or distilled water.
- Containers, brushes, paper towels.
- Personal protective equipment, including nitrile (or other material depending upon the nature of the chemicals we expect to encounter) or powderless surgical gloves and safety glasses. Tough work gloves may also be required for moving around equipment before or after the sampling itself. Other PPE include traffic vest, steel-toed safety shoes, hearing protection devices, long-sleeved shirt and long pants, and possibly a respirator if there is volatilization of chemicals, etc.

8.0 METHODS

This section describes the sequence of events to follow for sample collection in the field.

8.1 Equipment Decontamination Method

The decontamination protocol is essential to the quality of the sampling procedure as well as essential to ensuring that chemicals stay at the project site and are not tracked or carried elsewhere. The decontamination procedure should be designed and constructed to work on the chemicals of interest and contain the rinsate and solids within the contamination reduction zone.

Before sampling begins any non-dedicated or non-disposible equipment, well probes, pumps, and pump hoses shall be decontaminated.

Decontamination will be performed on all non-dedicated sampling equipment that may contact potentially contaminated water, including water level probes, fiberglass tapes, Teflon bailers, and non-dedicated pump hoses. Clean nitrile gloves (or other appropriate material depending upon the chemicals involved) or powderless surgical gloves are to be worn during decontamination.

Each piece of sampling equipment will also be decontaminated between each well. The decontamination procedure for most equipment will be as follows:

- Disassemble equipment (i.e., bladder pump).
- Wash equipment in an Alconox™ (or equivalent) and water solution using a brush or clean cloth to ensure removal of all contaminants.
- Rinse equipment in fresh tap water. Re-rinse with de-ionized water or distilled water.
- Dry equipment with paper towel and place in clean place, if appropriate.

The effectiveness of these decontamination procedures will be verified by vigorous QA/QC protocols, including blanks, duplicates, and spikes.

The rinsate water will be sufficient to prevent the Alconox™ solution (or equivalent) from entering the well. If a submersible pump is used to evacuate wells, the pump shall be decontaminated prior to use in each well. The procedure consists of immersing the pump, discharge tubing, and drop wire in an Alconox™ solution (or equivalent) and circulating the solution through the system. After washing, the circulating procedure will be repeated three (3) times with clean tap water. Samples of the tap water used as rinsate for the jet pump and/or submersible pump will be submitted for analysis. The analyses will be the same test methods used as water samples collected from the wells on site.

In addition to the above procedures for the jet and submersible pumps and other pieces of equipment, each of the decontamination solutions will be replaced with clean solution between each decontamination operation (i.e., between each well).

8.2 Well Evacuation Method

The purpose of well purging is to remove stagnant water from the well and obtain fresh water from the geologic material screened by the well.

Static water levels shall be measured for each well immediately before evacuating the well for sampling. This procedure shall be accomplished with a measuring probe or by the use of a chalked fiberglass tape. Water levels will be measured from the elevation reference point marked on the PVC inner casing. Regardless of the tools used, the measuring process will be repeated until consecutive water level measurements agree to within ± 0.01 foot. If floating product is historically known to occur in a well or if there is reason to believe there will be floating product in a new well, an interface probe will be used to measure the depth to water and the thickness of the floating material.

For wells that have been sampled previously, the purging method will be determined by the historic yield of the well. For new wells, the purging method will be based on past experience with wells screened in similar geologic materials.

If a pump is used, the type will be dependent upon the depth of the well. Typically, shallow high yield wells will be purged with a jet pump, and deep high yield wells will be purged with a submersible pump.

Purge water will be containerized and labled for approriate disposal.

The following sampling procedure is performed at each well:

- Note well condition, and any unusual conditions of the area immediately surrounding the well.
- Remove well cover and unlock cap.
- If necessary, evacuate any standing water within well box prior to removing inner well caps.
- When inner well caps are removed, perform head space analysis using a PID (as required).

- Measure and record depth to static water level from measuring point on PVC inner well casing. Repeat the measurement process until values agree within ± 0.01 feet. Indicate time of measurement.
- Record total depth of well (measured during water level measurement process) and use this depth to calculate volume of water in well (casing volume) in feet (of water) and gallons.
- When using a pump for evacuation, the pump intake will be initially placed in the center of the well screen.

8.3 Obtaining Water Samples

Groundwater samples shall be collected as soon as the water parameters have stabilized.

Sampling shall be accomplished with either a dedicated PVC bailer, a Teflon sampling bailer, a disposable bailer, or other sampling equipment. Bailers will be lowered into the well using either a Teflon-coated wire rope or disposable (one time use) polypropylene cord. Clean nitrile or powderless surgical gloves shall be worn by sampling personnel and changed often during all sampling procedures. Gloves shall be changed between purging and sampling

The following sampling procedure is to be used at each well:

- Assemble decontaminated sampling equipment.
- Don clean nitrile or powderless surgical gloves immediately before obtaining sample.
- Label sample containers.
- Obtain sample from well using a Teflon bailer, a disposable bailer, a dedicated PVC bailer, or directly from the pump tubing or permanent sampling apparatus. Care will be taken when using a bailer to minimize degassing or contamination of the sample, therefore the bailer will be submerged and withdrawn slowly to avoid splashing. The bailer will not be placed on the ground. The bailer will be lowered to the screened interval before sampling unless a nonaqueous floating layer is present, in which case the bailer will be submerged to just below the water table. Similar procedures apply for the use of a bladder pump.
- Transfer sample water directly into pre-preserved sample bottles provided by the laboratory, maintaining a slow linear flow with as little aeration as possible. The individual sample bottles will be filled and immediately capped in the order given below or as required by the analytical protocol:
    - Volatile organic compounds (VOCs)
    - Semivolatile organic compounds
    - Priority Pollutant Metals
    - General Minerals

- After each sample is collected, place the bottles in self-sealing plastic or bubble bags, seal the bags, and immediately place the bags in a chilled cooler with ice or frozen ice packs.

- Water samples collected with a bladder pump for metal and general mineral analyses will be filtered in the field with an in-line filter attached to the pump discharge hose if needed. These samples can be analyzed for dissolved metal content. Samples collected with a sampling bailer for metal analysis will be analyzed for total metal content. The turbidity of such samples will be recorded in the field notebook and/or data collection form to allow a qualitative evaluation of the degree to which metal concentrations could be associated with suspended matter.

- Record sample number, time of sampling, location, and sampler on the Ground Water Sample Collection Data Form.

- Replace well cap, close well cover, and lock well.

- Complete chain-of-custody form for transportation of samples to lab.

- Hand deliver or ship samples to the lab on the same day they are collected, or as soon afterwards as possible.

8.4 Sample Filtration Method

The following filtering procedures shall be used on samples collected for filtered metal and general mineral analyses using a bladder pump. Clean nitrile or powderless surgical gloves will be worn during this procedure.

- Connect in-line filter capsule (0.45 micron pore size) to bladder pump tubing.

- Pre-rinse the filter (2 to 3 gallons for filters with a 750 cm^2 effective filtration area), with organic-free deionized water.

- Fill sample bottle containing necessary preservatives.

- Store filtered samples in a chilled cooler with ice or frozen ice packs.

- Discard filter.

If, for some reason, filtration of bailer-collected samples is desired or appropriate, the following filtration procedure will be followed. Clean nitrile or powderless surgical gloves will be worn during this procedure.

- Place a new 0.45 filter membrane on the filter plate and assemble the (decontaminated) filter holder.

- Transfer information from sample label on the sample collected in the field (these samples will have been collected in sample bottles without preservatives) to new sample bottle (containing preservative, if appropriate).

- Place filtration tube in the sample bottle containing the unfiltered solution.
- Place new sample bottle (containing necessary preservatives) under filtering unit.
- Turn on pump and filter sample at less than 25 psi.
- Store filtered samples in chilled cooler with ice or frozen ice packs.
- Remove and dispose of used filter membrane.
- Rinse filtration plate and all parts of filtering apparatus that contacted the water sample with deionized water.
- Decontaminate any filtering glassware in an Alconox™ (or equivalent) solution, followed by rinses with tap water, a 1:1 nitric acid/purified water solution or 0.1 normal HCl, and finally organic-free deionized water.

8.5 Decontamination Methods

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed so that the solutions used are appropriate for the chemicals of concern.
- Personnel will don appropriate safety equipment to reduce personal exposure.
- Equipment that will not be damaged by water will be placed in a wash tub containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Equipment will then be rinsed in a second wash tub.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and wiped with organic-free deionized water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent possible contamination. Single use equipment and consumables will be discarded in an appropriate manner.

8.6 Sample Containers, Storage, and Holding Times

Refer to the Project SAP for project specific instructions on proper containers, storage of samples and allowable holding times.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

Outline quality control checking procedures, including frequency requirements and acceptance criteria. Acceptance criteria may take the form of an illustration such as a chart of acceptable results with tolerances, or other appropriate forms.

10.0 DOCUMENTATION

A record will be maintained during the purging procedure that will contain, at a minimum:

- Initial depth to water
- Volume of water removed
- Purging method
- Physical parameters of the purged water
- How purge water was contained (drum, tank, bucket, etc.)

The data shall be recorded on a Ground Water Sample Collection Data Form for each well that is evacuated and sampled.

Sampling information in the field book should contain, at a minimum, the following:

- Sample name, location, time, sampler, analysis
- Blind duplicates shall be noted on field notes (not chain-of-custody)
- Volume of water evacuated
- Time of sample collection
- Number of samples collected
- Sample identification numbers
- Preservation and storage of samples
- Filtration performed, if any
- Record of any QC samples from site
- Any irregularities or problems that may have a bearing on sampling quality
- Type of sampling equipment

In addition, proper documentation will include observance of the chain of custody procedures as described in the Project QAPP and SAP.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

Accurate and thorough documentation of field work conducted by Stantec is a vitally important component of project operations. Field notes, and the validity of the records kept in them, comprise a significant portion of Stantec's work product. Field notes represent legal records of our services and require a corresponding level of care and professionalism regardless of the grade of the field note taker.

Field notebooks should be complete in the field and serve as a primary source of information enabling a third-party to easily reconstruct the chronology of field events, even if applicable field forms (i.e., chain-of-custody forms) are lost or destroyed.

This Field Notebook Standard Operating Procedure (SOP) has been prepared as guidance for collecting and managing field notes, such that these records are collected in a consistent manner throughout Stantec.

2.0 DEFINITIONS

COC	Chain-of-Custody
FSP	Field Sampling Plan
HASP	Site-Specific Health and Safety Plan
O&M	Operation & Maintenance
PPE	Personal Protective Equipment
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
QAPP	Quality Assurance Project Plan
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Field notes should be used as a medium to describe all activities occurring at a site when Stantec is present with or without subcontractors or other contractors on site. Field notes should reflect the following information, at a minimum, concerning site health and safety observations:

1. Ambient site conditions (i.e., operating facility versus barren land).
2. Weather.
3. Traffic patterns.
4. Tailgate/Toolbox safety meeting time, place, and reference for notes.
5. HASP location and use.
6. Specific Personal Protective Equipment (PPE) used on site.
7. Sampling activities, types of media sampled, areas and times.

8. Contractors, visitors, and client representatives on site.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Field notebooks should document the project quality assurance standards, referencing one or more of the following:

1. A project-specific FSP, QAPP, or combined SAP.
2. A project WP.
3. An O&M manual with written procedures.
4. An SOP for the specific tasks or task.
5. Forms or Checklists developed by a project team for a specific task.

The field notebook must not only record the daily quality assurance expectations for each task conducted but it should also reference the accepted standards of practice for both Stantec personnel and subcontractors in meeting these expectations.

5.0 RESPONSIBILITIES

With regard to field work documentation, the following are the minimum responsibilities for each position listed:

Project Manager – Responsible for:

- Ensuring project personnel performing field work understand the project quality assurance objectives and scope of work (i.e., SAP, QAPP, or WP and HASP).
- Managing resources (labor, equipment, materials, subcontractors) to be utilized, schedule, project number, project-specific field note requirements.
- Explaining expectations for communication with the home office (i.e., check-in phone calls, faxing field notes and forms).

Field Personnel – Responsible for:

- Reading and understanding project scope of work, schedule, and quality assurance documents prior to conducting field work.
- Maintaining copies of project documents, including the HASP.
- Diligently making routine entries in the field notebook concerning progress on site sampling activities, and deviations from the planned scope of work and activities of

Stantec, its subcontractors, or other contractors/visitors to the site, and any other information relevant to the work being conducted.

- Regular communication with the Project Manager throughout the day.

Health and Safety Officer – Responsible for:

- Periodic inspection of field notebooks for information relevant to potential site Health & Safety concerns, including use of PPE, monitoring instrument calibrations and use, and verification of training certificates from on-site personnel.

Project Quality Assurance Officer (if applicable) – Responsible for:

- Periodic inspection of field notebook(s) to ensure applicability of the field notebook for the project and the relevance of the notes collected.

- Management of field notebook in the field and project files in the home office following field work.

6.0 TRAINING/QUALIFICATIONS

Field personnel are expected to be experienced in the site-specific scope of work being performed through study and understanding of the project quality assurance standards prior to entering the field. While prior field experience on projects of similar scope and complexity is recommended, personnel maintaining the field notebook must record routine observations during field activities, and document non-routine events at the site in accordance with the project plans. Field personnel qualifications include legible penmanship, the ability to prepare clear illustrations and/or sketches of site features and activities, and the ability to responsibly manage field notebooks during and after field work.

7.0 REQUIRED MATERIALS

The following materials are required for proper field work documentation:

1. Field Notebook (e.g., Rite In The Rain, Composition, etc.) with numbered pages or Stantec field report forms.

2. Black or blue ink or indelible marking pen (e.g., Staedler Article No. 318-9 Lumocolor or equivalent).

3. Wrist watch or clock.

4. Project Quality Assurance documents or forms.

5. Mobile telephone or radio.

6. Communication log with pertinent contact information for key project (both Stantec and non-Stantec) personnel.

7. Site plan or map of area where work is to be conducted for reference purposes.

8.0 METHODS

The following protocol outlines a methodology to collect and manage field work documentation in a consistent manner throughout Stantec.

Multiple notebooks may be used for a project, perhaps concurrently, and the field note takers must coordinate with the Project Manager and Project Quality Assurance Officer (if applicable) to coordinate sequential numbering of field books.

1. Beginning of Project Day

The following entries should be made at the beginning of each project:

A. Note the project name, address and location, (i.e., off-site versus on-site, operable unit name, SWMU, etc.);

B. Note the governing documents including HASP, QAPP, WP, etc., for performing the work; and,

C. Note any specific activities planned for the day (e.g., drilling monitoring wells MW-1 through MW-4, removing a waste oil tank, completing a survey of sensitive habitat, or delineating a potential wetland, etc.).

2. Routine Events

The following entries should be made throughout each day, including:

A. Enter time (preferably at 15-minute increments) or starting and ending points (i.e., started drilling, completed well, etc.);

B. Enter description of location (well/borehole name, well being sampled, developed, tank being removed, area being cleared);

C. Enter description of equipment and materials in use and subcontractors working or on standby;

D. Note any specific activities to be completed for the day, and reference accompanying forms or attachments that need to be appended to the field note book in the order of occurrence. These might include:

- Tailgate meeting form;
- Subsurface clearance checklists;
- Equipment calibration;
- Borehole logs/well completion forms;
- Groundwater monitoring forms;

- ❖ Purge and sampling record;
- ❖ Chain-of-custody;
- ❖ Subcontractor (drillers/concrete cutters) daily reports;
- ❖ Equipment records; and,
- ❖ Supplies purchased (to be reported on expense report).

Or, for a construction/removal project:

- ❖ Air monitoring forms;
- ❖ Soil or rock tags;
- ❖ Bill-of-lading/waste manifests; and,
- ❖ Photographic log.

E. Note any variances to the project plan, project quality, or project delays;

F. Entries are to be made in ink and incorrect entries are to be changed only through strike-out, and then initialed by the note taker. Do not "scribble" or color over notes;

G. Notes must be factual, relevant and professional. No opinions or conjectures are appropriate. Observations and interpretations must be clearly distinguished within the context of the entry. Slang and editorial comments are inappropriate for field notebooks;

H. If photographs are taken, a photograph log should be maintained detailing the time the photo was taken, the name of the photographer, the direction of view in the photo, the content of the photo and any significant points to observe in photo; and,

I. Initial each page and sign and date the field notebook on the last page for each day.

3. Non-routine/significant events

A. Enter time (exact military time);

B. Record full yet concise description of any non-routine occurrence, such as an incident (i.e., spill, fire, motor vehicle accident) or other events (e.g., EPA inspection) beyond the scope of the scheduled work; and,

C. As applicable, multiple photographs should be taken to document the variance or incident.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Quality Control Checks are required at the following points during the field notebook documentation process:

1. Prior to entering the field, the Project Manager should ensure that field personnel have read the project quality assurance documents and that these are available for reference in the field;

2. At the end of each field day, personnel are responsible to forward copies of field notebook pages and supporting documentation to the Project Manager or designee;

3. At the completion of the phase of work and/or the end of the project, field notebooks must be assembled in the home office project file;

4. Working copies of filed notebooks should be used within the home office rather than the original notebooks; and,

5. Use referenced Stantec forms, as attachments, described in Article 10.0, Documentation.

10.0 DOCUMENTATION

The following information (referenced in the field notebook), drawings and/or forms, as applicable, should be provided via facsimile to the Project Manager daily (at a minimum) unless otherwise specified by the Project Manager:

- Photographs (i.e., color thumbnail digital photos).
- Equipment records.
- Revised maps and survey notes:
  - Corrections to existing site features (add new features; remove obsolete features), as applicable.
  - Placement of new wells/borings (with measured distances).
  - Preliminary ground water elevation contour map based on new data.
- Subsurface clearance checklist from HASP.
- HASP acknowledgement form, updated as needed.
- Chain-of-custody record.
- Variance/delay form (ERPA-302).
- Waste management form (ERPA-303).
- Borehole logs and well completion diagrams (ERPA-304-20/40).
- Purging, monitoring, sampling, and development records (ERPA-305 and ERPA-306).

The following documentation list is provided for use with this field note documentation SOP:

- Field Report (ERPA-301).
- Variance/Time Delay Form (ERPA-302).

- Waste Management Form (ERPA-303).
- Borehole log and well construction detail template ERPA-304-20/40.
- Field Note Checklist (ERPA-601).
- Field Supplies Checklist (ERPA-602).

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

Stantec	Field Report	ERPA-301 Page 1 of 1 Rev. 1 Apr 2011

PC & OFFICE	DATE	PAGE	CLIENT
	PROJECT NO.	TASK NO.	SUBCONTRACTOR
TO:	LOCATION		
	WEATHER		TEMP.

CHRONOLOGY OF FIELD ACTIVITIES/ISSUES/OBSERVATIONS

EQUIPMENT USED:	SUBCONTRACTOR HOURS:	STAFF HOURS:
MILEAGE:	REVIEWED BY:	
cc:	PREPARED BY:	

Stantec	Variance / Time Delay Form	ERPA-302	
		Page 1 of 1	
		Rev. 1.1	Apr 2011

Site Name _____

Location _____

Stantec Project No. _____

The purpose of this form is to document variances from the Work Plan scope or design specifications and/or document instances of time delays. Fax or deliver to the Stantec project office with the daily report. Please print legibly.

Variance / Time Delay Began	Variance / Time Delay Ended	Duration of Variance / Time Delay
_____	_____	_____
Date & Time	Date & Time	

Description of Variance

Work Plan Task / Spec Section _____

Reason for Delay AND/OR Variance

Stantec Personnel _____
Print

Signature _____ **Date** _____

THIS INFORMATION FOR AUTHORIZED COMPANY USE ONLY
STANTEC CONSULTING

Stantec	Waste Management Form	ERPA-303	
		Page 1 of 1	
		Rev. 1	Apr 2011

Project Name _____ **Project Manager** _____

Site Location _____ **Project Number** _____

Date of Generation	Manifest/ Container No.	Waste Type	Type of Waste Container	No. of Containers	Volume of Waste	Company Responsible for Transportation	Date of Off-Site Transpor-tation	Disposal Facility	Waste Characterization Submitted To	Date of Submittal	Date of Disposal

Stantec	Groundwater Sampling Field Data Sheet Form	ERPA-306A	
		Page 1 of 1	
		Rev. 2	Nov 2012

Stantec PN: 182612301.501.681 DATE: _____ WELL NO. _____

FACILITY NAME: BP-215 TEMPERATURE: _____ °F or °C

FIELD PERSONNEL: _____ WEATHER: _____

FIELD MEASUREMENTS:

A. Static Water Level (SWL) below top of casing/piezometer: _____ FT. or IN.
B. Thickness of Free Product, if present: _____ Inches _____ FT. or IN.
C. Total Depth of well (TD) from top of casing/piezometer: _____ FT. or IN.
D. Height of Water Column (WC) in casing (WC = TD – SWL): _____ FT. or IN.
E. Volumes (V) per foot of water column: _____ _____
F. Well Volume (WV) in casing (WV = V x WC): _____ Gal.
G. Total Purge Volume (PV = WV x 3): _____ Gal.

	3 Well Vols.	5 Well Vols.	
1" Diameter =	0.12 gals/ft.	0.20 gals/ft.	x feet of water _____ = _____ PV(Gal)
2" Diameter =	0.5 gals/ft.	0.82 gals/ft.	x feet of water _____ = _____ PV(Gal)
4" Diameter =	2.0 gals/ft.	3.25 gals/ft.	x feet of water _____ = _____ PV(Gal)

PURGING METHOD: _____ DURATION: _____

OBSERVATIONS:

	Time	Turbidity	Sheen	Temp °C	Cond mS/cm	DO mg/L	pH.	ORP
1st Volume:								
2nd Volume:								
3rd Volume:								

TOTAL VOLUME OF WATER PURGED FROM WELL: _____

PURGE WATER STORED/DISPOSED OF WHERE/HOW: _____

SAMPLES COLLECTED: Depth to Water at time of sample collection: _____

Sample ID(s)	Analytical Parameter	Time	Size/Number of Container(s)	Preservative

COMMENTS:

Casing Capacities:
2-inch hole.....0.16 gal/lin ft
4-inch hole.....0.65 gal/lin ft
6.5-inch hole.....1.70 gal/lin ft
8-inch hole.....2.60 gal/lin ft
10-inch hole.....4.10 gal/lin ft

Recharge Calculation at Time of Sample Collection:

Total Depth of Well:
Original Water Column: _____ x 0.80 = _ (_____)
Collect sample with Depth to Water measures **Less than or equal to:**

Signature _____

Stantec

APPENDIX D
TACO REFERENCE TABLES
Quality Assurance Project Plan
Site Investigation
BP Products North America Site, Inc. Site #5482

Section 742.APPENDIX A General

Section 742.TABLE G Concentrations of Inorganic Chemicals in Background Soils

Chemical Name	Counties Within Metropolitan Statistical Areas (mg/kg)	Counties Outside Metropolitan Statistical Areas (mg/kg)
Aluminum	9,500	9,200
Antimony	4.0	3.3
Arsenic	13.0	11.3
Barium	110	122
Beryllium	0.59	0.56
Cadmium	0.6	0.50
Calcium	9,300	5,525
Chromium	16.2	13.0
Cobalt	8.9	8.9
Copper	19.6	12.0
Cyanide	0.51	0.50
Iron	15,900	15,000
Lead	36.0	20.9
Magnesium	4,820	2,700
Manganese	636	630
Mercury	0.06	0.05
Nickel	18.0	13.0
Potassium	1,268	1,100
Selenium	0.48	0.37
Silver	0.55	0.50
Sodium	130	130.0
Sulfate	85.5	110
Sulfide	3.1	2.9
Thallium	0.32	0.42
Vanadium	25.2	25.0
Zinc	95.0	60.2

BOARD NOTE: Counties within Metropolitan Statistical Areas: Boone, Champaign, Clinton, Cook, DuPage, Grundy, Henry, Jersey, Kane, Kankakee, Kendall, Lake, Macon, Madison, McHenry, McLean, Menard, Monroe, Peoria, Rock Island, Sangamon, St. Clair, Tazewell, Will, Winnebago and Woodford.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX A: General

Section 742.TABLE H Concentrations of Polynuclear Aromatic Hydrocarbon Chemicals in Background Soils

Chemical Name	Chicago[a] mg/kg	Metropolitan Areas[b] (mg/kg)	Non-Metropolitan Areas[c] (mg/kg)
2-Methylnaphthalene	-----	0.14	0.29
Acenaphthene	0.09	0.13	0.04
Acenaphthylene	0.03	0.07	0.04
Anthracene	0.25	0.40	0.14
Benzo(a)anthracene	1.1	1.8	0.72
Benzo(a)pyrene	1.3	2.1	0.98
Benzo(b)fluoranthene	1.5	2.1	0.70
Benzo(g,h,i)perylene	0.68	1.7	0.84
Benzo(k)fluoranthene	0.99	1.7	0.63
Chrysene	1.2	2.7	1.1
Dibenzo(a,h)anthracene	0.20	0.42	0.15
Fluoranthene	2.7	4.1	1.8
Fluorene	0.10	0.18	0.04
Indeno(1,2,3-c,d)pyrene	0.86	1.6	0.51
Naphthalene	0.04	0.20	0.17
Phenanthrene	1.3	2.5	0.99
Pyrene	1.9	3.0	1.2

[a] Chicago means within the corporate limits of the City of Chicago.

[b] Metropolitan area means a populated area, as defined in Section 742.200, (other than the City of Chicago) that is located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

[c] Non-Metropolitan area means a populated area, as defined in Section 742.200, that is not located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

(Source: Appendix A, Table H renumbered to Appendix A, Table I and new Appendix A, Table H Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE A Tier 1 Soil Remediation Objectives[a] for Residential Properties

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	4,700[b]	---[c]	570[b]	2,900	*
67-64-1	Acetone	70,000[b]	100,000[d]	25[b]	25	*
15972-60-8	Alachlor[o]	8[e]	---[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	78[b]	---[c]	0.013	0.07	NA
309-00-2	Aldrin	0.04[e]	3[e]	0.5[e]	2.5	0.94
120-12-7	Anthracene	23,000[b]	---[c]	12,000[b]	59,000	*
1912-24-9	Atrazine[o]	2700[b]	---[c]	0.066	0.33	NA
71-43-2	Benzene	12[e]	0.8[e]	0.03	0.17	*
56-55-3	Benzo(*a*)anthracene	0.9[e,w]	---[c]	2	8	*
205-99-2	Benzo(*b*)fluoranthene	0.9[e,w]	---[c]	5	25	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
207-08-9	Benzo(*k*)fluroanthene	9[e]	---[c]	49	250	*
50-32-8	Benzo(*a*)pyrene	0.09[e, w]	---[c]	8	82	*
111-44-4	Bis(2-chloroethyl)ether	0.6[e]	0.2[e]	0.0004[e]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	46[e]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	10[e]	3,000[d]	0.6	0.6	*
75-25-2	Bromoform	81[e]	53[e]	0.8	0.8	*
71-36-3	Butanol	7,800[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	16,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	32[e]	---[c]	0.6[e]	2.8	NA
1563-66-2	Carbofuran[o]	390[b]	---[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	7,800[b]	720[d, x]	32[b]	160	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
56-23-5	Carbon tetrachloride	5[e]	0.3[e]	0.07	0.33	*
57-74-9	Chlordane	1.8[e]	72[e, x]	10	48	*
106-47-8	4-Chloroaniline (*p*-Chloroaniline)	310[b]	---[c]	0.7[b]	0.7	*
108-90-7	Chlorobenzene (Monochlorobenzene)	1,600[b]	130[b, x]	1	6.5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	1,600[b]	1,300[d]	0.4	0.4	*
67-66-3	Chloroform	100[e]	0.3[e]	0.6	2.9	*
218-01-9	Chrysene	88[e]	---[c]	160	800	*
94-75-7	2,4-D[o]	780[b]	---[c]	1.5	7.7	*
75-99-0	Dalapon[o]	2,300[b]	---[c]	0.85	8.5	*
72-54-8	DDD	3[e]	---[c]	16[e]	80	*
72-55-9	DDE	2[e]	---[c]	54[e]	270	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
50-29-3	DDT	2[e]	---[g, x]	32[e]	160	*
53-70-3	Dibenzo(*a,h*)anthracene	0.09[e, w]	---[c]	2	7.6	*
96-12-8	1,2-Dibromo-3-chloropropane	0.46[e]	11[b, x]	0.002	0.02	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.32[e]	0.06[e]	0.0004	0.004	0.005
84-74-2	Di-*n*-butyl phthalate	7,800[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	7,000[b]	560[d, x]	17	43	*
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	---[c]	11,000[b, x]	2	11	*
91-94-1	3,3'-Dichlorobenzidine	1[e]	---[c]	0.007[e,	0.033	1.3
75-34-3	1,1-Dichloroethane	7,800[b]	1,300[b, x]	23[b]	110	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	7[e]	0.4[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	3,900[b]	290[b, x]	0.06	0.3	*
156-59-2	*cis*-1,2-Dichloroethylene	780[b]	1,200[d]	0.4	1.1	*
156-60-5	*trans*-1,2-Dichloroethylene	1,600[b]	3,100[d]	0.7	3.4	*
78-87-5	1,2-Dichloropropane	9[e]	15[b, x]	0.03	0.15	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	6.4[e]	1.1[e, x]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.04[e]	1[e]	0.004[e]	0.02	0.603
84-66-2	Diethyl phthalate	63,000[b]	2,000[d]	470[b]	470	*
105-67-9	2,4-Dimethylphenol	1,600[b]	---[c]	9[b]	9	*
121-14-2	2,4-Dinitrotoluene	0.9[e]	---[c]	0.0008[e,	0.0008	0.250

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
606-20-2	2,6-Dinitrotoluene	0.9[e]	---[c]	0.0007[e]	0.0007	0.260
117-84-0	Di-*n*-octyl phthalate	1,600[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan[o]	470[b]	---[c]	18[b]	90	*
145-73-3	Endothall[o]	1,600[b]	---[c]	0.4	0.4	NA
72-20-8	Endrin	23[b]	---[c]	1	5	*
100-41-4	Ethylbenzene	7,800[b]	400[d, x]	13	19	*
206-44-0	Fluoranthene	3,100[b]	---[c]	4,300[b]	21,000	*
86-73-7	Fluorene	3,100[b]	---[c]	560[b]	2,800	*
76-44-8	Heptachlor	0.1[e]	0.1[e]	23	110	0.871
1024-57-3	Heptachlor epoxide	0.07[e]	5[e]	0.7	3.3	1.005
118-74-1	Hexachlorobenzene	0.4[e]	1[e]	2	11	*
319-84-6	*Alpha*-HCH (*alpha*-BHC)	0.1[e]	0.8[e]	0.0005[e]	0.003	0.0074

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
58-89-9	*Gamma*-HCH (Lindane)[n]	0.5[e]	---[c, x]	0.009	0.047	*
77-47-4	Hexachlorocyclopentadiene	550[b]	10[b, x]	400	2,200[d]	*
67-72-1	Hexachloroethane	78[b]	---[c]	0.5[b]	2.6	*
193-39-5	Indeno(1,2,3-*c,d*)pyrene	0.9[e,w]	---[c]	14	69	*
78-59-1	Isophorone	15,600[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor[o]	390[b]	---[c]	160	780	*
74-83-9	Methyl bromide (Bromomethane)	110[b]	10[b, x]	0.2[b]	1.2	*
1634-04-4	Methyl tertiary-butyl ether	780[b]	8,800[d, x]	0.32	0.32	*
75-09-2	Methylene chloride (Dichloromethane)	85[e]	13[e]	0.02[e]	0.2	*
95-48-7	2-Methylphenol (*o* – Cresol)	3,900[b]	---[c]	15[b]	15	*
91-20-3	Naphthalene	1,600[b]	170[b, x]	12[b]	18	*
98-95-3	Nitrobenzene	39[b]	92[b, x]	0.1[b,	0.1	0.26

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
86-30-6	*N*-Nitrosodiphenylamine	130[e]	---[c]	1[e]	5.6	*
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.09[e]	---[c]	0.00005[e]	0.00005	0.0018
108-95-2	Phenol	23,000[b]	---[c]	100[b]	100	*
1918-02-1	Picloram[o]	5,500[b]	---[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1[h]	---[c,h]	---[h]	---[h]	*
129-00-0	Pyrene	2,300[b]	---[c]	4,200[b]	21,000	*
122-34-9	Simazine[o]	390[b]	---[c]	0.04	0.37	NA
100-42-5	Styrene	16,000[b]	1,500[d, x]	4	18	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	12[e]	11[e]	0.06	0.3	*
108-88-3	Toluene	16,000[b]	650[d, x]	12	29	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
8001-35-2	Toxaphene[n]	0.6[e]	89[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	780[b]	3,200[b, x]	5	53	*
71-55-6	1,1,1-Trichloroethane	---[c]	1,200[d]	2	9.6	*
79-00-5	1,1,2-Trichloroethane	310[b]	1,800[d]	0.02	0.3	*
79-01-6	Trichloroethylene	58[e]	5[e]	0.06	0.3	*
108-05-4	Vinyl acetate	78,000[b]	1,000[b, x]	170[b]	170	*
75-01-4	Vinyl chloride	0.46[e]	0.28[e]	0.01	0.07	*
108-38-3	m-Xylene	16,000[b]	420[d, x]	210	210	*
95-47-6	o-Xylene	16,000[b]	410[d, x]	190	190	*
106-42-3	p-Xylene	16,000[b]	460[d, x]	200	200	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
1330-20-7	Xylenes (total)	16,000[b]	320[d, x]	150	150	*
	Ionizable Organics					
65-85-0	Benzoic Acid	310,000[b]	---[c]	400[b,i]	400[i]	*
95-57-8	2-Chlorophenol	390[b]	53,000[d]	4[b,i]	4[i]	*
120-83-2	2,4-Dichlorophenol	230[b]	---[c]	1[b,i]	1[i]	*
51-28-5	2,4-Dinitrophenol	160[b]	---[c]	0.2[b,]	0.2	3.3
88-85-7	Dinoseb[o]	78[b]	---[c]	0.34[b,i]	3.4[i]	*
87-86-5	Pentachlorophenol	3[e,j]	---[c]	0.03[i]	0.14[i]	*
93-72-1	2,4,5-TP (Silvex)	630[b]	---[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	7,800[b]	---[c]	270[b,i]	1,400[i]	*
88-06-2	2,4,6 Trichlorophenol	58[e]	200[e]	0.2[e, i]	0.77[i]	0.66

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
	Inorganics					
7440-36-0	Antimony	31[b]	---[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	---[t]	750[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	5,500[b]	690,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	160[b]	1,300[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	16,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	78[b, r]	1,800[e]	0.005[m]	0.05[m]	*
7440-70-2	Calcium[n]	---[g]	---[c]	---[c]	---[c]	*
16887-00-6	Chloride	---[c]	---[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	230[b]	270[e]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	120,000[b]	---[c]	---[g]	---[g]	*
18540-29-9	Chromium, ion, hexavalent	230[b]	270[e]	---	---	*

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-48-4	Cobalt	4,700[b]	---[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	2,900[b]	---[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	1,600[b]	---[c]	0.2[q,m]	0.6[q,m]	*
7782-41-4	Fluoride	4,700[b]	---[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	---[c]	---[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	400[k]	---[c]	0.0075[m]	0.1[m]	*
7439-95-4	Magnesium[n]	325,000	---[c]	---[c]	---[c]	*
7439-96-5	Manganese	1,600 [b,v]	69,000[b, x]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n,s]	23[b]	10[b, x]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	1,600[b]	13,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	130,000[b]	---[c]	10.0[q, m]	100[q]	*
7723-14-0	Phosphorus[n]	---[g]	---[c]	---[c]	---[c]	*

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-09-7	Potassium[n]	---[g]	---[c]	---[c]	---[c]	*
7782-49-2	Selenium[l,n]	390[b]	---[c]	0.05[m]	0.05[m]	*
7440-22-4	Silver	390[b]	---[c]	0.05[m]	---[c]	*
7440-23-5	Sodium[n]	---[g]	---[c]	---[c]	---[c]	*
14808-79-8	Sulfate	---[c]	---[c]	400[m]	400[m]	*
7440-28-0	Thallium	6.3[b,u]	---[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	550[b]	---[c]	0.049[m]	0.1[m]	*
7440-66-6	Zinc[l]	23,000[b]	---[c]	5.0[m]	10[m]	*

"*" indicates that the ADL is less than or equal to the specified remediation objective.
NA means not available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Remediation Objective Notations

[a] Soil remediation objectives based on human health criteria only.
[b] Calculated values correspond to a target hazard quotient of 1.
[c] No toxicity criteria available for the route of exposure.
[d] Soil saturation concentration ($C_{[sat]}$) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.
[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.
[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.
[h] 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Requests for approval of a Tier 3 evaluation must address the applicability of 40 CFR 761.
[i] Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D of this Part.
[j] Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.
[k] A preliminary remediation goal of 400 mg/kg has been set for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, OSWER Directive #9355.4-12.
[l] Potential for soil-plant-human exposure.
[m] The person conducting the remediation has the option to use: 1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; 2) where applicable, the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or 3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.
[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.
[o] For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.
[p] For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.
[q] The TCLP extraction must be done using water at a pH of 7.0.
[r] Value based on dietary Reference Dose.

[s] Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.

[t] For the ingestion route for arsenic, see 742.Appendix A, Table G.

[u] Value based on Reference Dose for Thallium sulfate (CAS No. 7446-18-6).

[v] Value based on Reference Dose adjusted for dietary intake.

[w] For sites located in any populated area as defined in Section 742.200, Appendix A, Table H may be used.

[x] The remediation objectives for these chemicals must also include the construction worker inhalation objective in Appendix B, Table B.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table B Tier 1 Soil Remediation Objectives[a] for Industrial/Commercial Properties

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	120,000[b]	-----[c]	120,000[b]	-----[c]	570[b]	2,900	*
67-64-1	Acetone	----[g]	100,000[d]	----[g]	100,000[d]	25[b]	25	*
15972-60-8	Alachlor[o]	72[e]	-----[c]	1,600[e]	-----[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.013	0.07	NA
309-00-2	Aldrin	0.3[e]	6.6[e]	6.1[b]	9.3[e]	0.5[e]	2.5	0.94
120-12-7	Anthracene	610,000[b]	-----[c]	610,000[b]	-----[c]	12,000[b]	59,000	*
1912-24-9	Atrazine[o]	72,000[b]	-----[c]	7,100[b]	-----[c]	0.066	0.33	NA
71-43-2	Benzene	100[e]	1.6[e]	2,300[e]	2.2[e]	0.03	0.17	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
56-55-3	Benzo(*a*)anthracene	8[e]	-----[c]	170[e]	-----[c]	2	8	*
205-99-2	Benzo(*b*)fluoranthene	8[e]	-----[c]	170[e]	-----[c]	5	25	*
207-08-9	Benzo(*k*)fluroanthene	78[e]	-----[c]	1,700[e]	-----[c]	49	250	*
50-32-8	Benzo(*a*)pyrene	0.8[e,x]	-----[c]	17[e]	-----[c]	8	82	*
111-44-4	Bis(2-chloroethyl)ether	5[e]	0.47[e]	75[e]	0.66[e]	0.0004[e]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	410[e]	31,000[d]	4,100[b]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	0.6	*
75-25-2	Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	0.8	*
71-36-3	Butanol	200,000[b]	10,000[d]	200,000[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	410,000[b]	930[d]	410,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	290[e]	-----[c]	6,200[e]	-----[c]	0.6[e]	2.8	NA

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1563-66-2	Carbofuran[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	160	*
56-23-5	Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	0.33	*
57-74-9	Chlordane	16[e]	140[e]	100[b]	22[b]	10	48	*
106-47-8	4 – Chloroaniline (*p*-Chloroaniline)	8,200[b]	-----[c]	820[b]	-----[c]	0.7[b]	0.7	*
108-90-7	Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	6.5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	0.4	*
67-66-3	Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	2.9	*
218-01-9	Chrysene	780[e]	-----[c]	17,000[e]	-----[e]	160	800	*
94-75-7	2,4-D[o]	20,000[b]	-----[c]	2,000[b]	-----[c]	1.5	7.7	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-99-0	Dalapon[o]	61,000[b]	-----[c]	6,100[b]	-----[c]	0.85	8.5	*
72-54-8	DDD	24[e]	-----[c]	520[e]	-----[c]	16[e]	80	*
72-55-9	DDE	17[e]	-----[c]	370[e]	-----[c]	54[e]	270	*
50-29-3	DDT	17[e]	1,500[e]	100[b]	2,100[e]	32[e]	160	*
53-70-3	Dibenzo(*a,h*)anthracene	0.8[e]	-----[c]	17[e]	-----[c]	2	7.6	*
96-12-8	1,2-Dibromo-3-chloropropane	4[e]	17[b]	89[e]	0.11[b]	0.002	0.02	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	2.9[e]	0.12[e]	62[e]	0.16[e]	0.0004	0.004	0.005
84-74-2	Di-*n*-butyl phthalate	200,000[b]	2,300[d]	200,000[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	180,000[b]	560[d]	18,000[b]	310[b]	17	43	*
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	-----[c]	17,000[b]	-----[c]	340[b]	2	11	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction - Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
91-94-1	3,3'-Dichlorobenzidine	13[e]	-----[c]	280[e]	-----[c]	0.007[e]	0.033	1.3
75-34-3	1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	110	*
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	100,000[b]	470[b]	10,000[b]	3.0[b]	0.06	0.3	*
156-59-2	*cis*-1,2-Dichloroethylene	20,000[b]	1,200[d]	20,000[b]	1,200[d]	0.4	1.1	*
156-60-5	*Trans*-1,2-Dichloroethylene	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	3.4	*
78-87-5	1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	0.15	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	57[e]	2.1[e]	1,200[e]	0.39[b]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.4[e]	2.2[e]	7.8[e]	3.1[e]	0.004[e]	0.02	0.603
84-66-2	Diethyl phthalate	1,000,000[b]	2,000[d]	1,000,000[b]	2,000[d]	470[b]	470	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
105-67-9	2,4-Dimethylphenol	41,000[b]	-----[c]	41,000[b]	-----[c]	9[b]	9	*
121-14-2	2,4-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0008[e]	0.0008	0.250
606-20-2	2,6-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0007[e]	0.0007	0.260
117-84-0	Di-*n*-octyl phthalate	41,000[e]	10,000[d]	4,100[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan[o]	12,000[b]	-----[c]	1,200[b]	-----[c]	18[b]	90	*
145-73-3	Endothall[o]	41,000[c]	-----[c]	4,100[b]	-----[c]	0.4	0.4	NA
72-20-8	Endrin	610[b]	-----[c]	61[b]	-----[c]	1	5	*
100-41-4	Ethylbenzene	200,000[b]	400[d]	20,000[b]	58[b]	13	19	*
206-44-0	Fluoranthene	82,000[b]	-----[c]	82,000[b]	-----[c]	4,300[b]	21,000	*
86-73-7	Fluorene	82,000[b]	-----[c]	82,000[b]	-----[c]	560[b]	2,800	*
76-44-8	Heptachlor	1[e]	11[e]	28[e]	16[e]	23	110	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1024-57-3	Heptachlor epoxide	0.6[e]	9.2[e]	2.7[b]	13[e]	0.7	3.3	1.005
118-74-1	Hexachlorobenzene	4[e]	1.8[e]	78[e]	2.6[e]	2	11	*
319-84-6	*Alpha*-HCH (*alpha*-BHC)	0.9[e]	1.5[e]	20[e]	2.1[e]	0.0005[e]	0.003	0.0074
58-89-9	*Gamma*-HCH (Lindane)[n]	4[e]	-----[c]	96[e]	-----[c]	0.009	0.047	*
77-47-4	Hexachlorocyclopentadiene	14,000[b]	16[b]	14,000[b]	1.1[b]	400	2,200[d]	*
67-72-1	Hexachloroethane	2,000[b]	-----[c]	2,000[b]	-----[c]	0.5[b]	2.6	*
193-39-5	Indeno(1,2,3-*c,d*)pyrene	8[e]	-----[c]	170[e]	-----[c]	14	69	*
78-59-1	Isophorone	410,000[b]	4,600[d]	410,000[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	160	780	*
74-83-9	Methyl bromide (Bromomethane)	2,900[b]	15[b]	1,000[b]	3.9[b]	0.2[b]	1.2	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1634-04-4	Methyl tertiary-butyl ether	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	0.32	*
75-09-2	Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	0.2	*
95-48-7	2-Methylphenol (*o* – Cresol)	100,000[b]	-----[c]	100,000[b]	-----[c]	15[b]	15	*
86-30-6	*N*-Nitrosodiphenylamine	1,200[e]	-----[c]	25,000[e]	-----[c]	1[e]	5.6	*
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.8[e]	-----[c]	1.8[e]	-----[c]	0.00005[e]	0.00005	0.0018
91-20-3	Naphthalene	41,000[b]	270[b]	4,100[b]	1.8[b]	12[b]	18	*
98-95-3	Nitrobenzene	1,000[b]	140[b]	1,000[b]	9.4[b]	0.1[b]	0.1	0.26
108-95-2	Phenol	610,000[b]	-----[c]	61,000[b]	-----[c]	100[b]	100	*
1918-02-1	Picloram[o]	140,000[b]	-----[c]	14,000[b]	-----[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1[h]	-----[c,h]	1[h]	-----[c,h]	-----[h]	-----[h]	*
129-00-0	Pyrene	61,000[b]	-----[c]	61,000[b]	-----[c]	4,200[b]	21,000	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
122-34-9	Simazine[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.04	0.37	NA
100-42-5	Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	18	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	0.3	*
108-88-3	Toluene	410,000[b]	650[d]	410,000[b]	42[b]	12	29	*
8001-35-2	Toxaphene[n]	5.2[e]	170[e]	110[e]	240[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	20,000[b]	3,200[d]	2,000[b]	920[b]	5	53	*
71-55-6	1,1,1-Trichloroethane	-----[c]	1,200[d]	-----[c]	1,200[d]	2	9.6	*
79-00-5	1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	0.3	*
79-01-6	Trichloroethylene	520[e]	8.9[e]	1,200[b]	12[e]	0.06	0.3	*
108-05-4	Vinyl acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	170	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-01-4	Vinyl chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.07	*
108-38-3	m-Xylene	410,000[b]	420[d]	41,000[b]	6.4[b]	210	210	*
95-47-6	o-Xylene	410,000[b]	410[d]	41,000[b]	6.5[b]	190	190	*
106-42-3	p-Xylene	410,000[b]	460[d]	41,000[b]	5.9[b]	200	200	*
1330-20-7	Xylenes (total)	410,000[b]	320[d]	41,000[b]	5.6[b]	150	150	*
	Ionizable Organics							
65-85-0	Benzoic Acid	1,000,000[b]	-----[c]	820,000[b]	-----[c]	400[b,i]	400[i]	*
95-57-8	2-Chlorophenol	10,000[b]	53,000[d]	10,000[b]	53,000[d]	4[b, i]	20[i]	*
120-83-2	2,4-Dichlorophenol	6,100[b]	-----[c]	610[b]	-----[c]	1[b, i]	1[i]	*
51-28-5	2,4-Dinitrophenol	4,100[b]	-----[c]	410[b]	-----[c]	0.2[b, i]	0.2[i]	3.3
88-85-7	Dinoseb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.34[b, i]	3.4[i]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
87-86-5	Pentachlorophenol	24[e,j]	-----[c]	520[e,j]	-----[c]	0.03[i]	0.14[i]	*
93-72-1	2,4,5-TP (Silvex)	16,000[b]	-----[c]	1,600[b]	-----[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	200,000[b]	-----[c]	200,000[b]	-----[c]	270[b,i]	1,400[i]	*
88-06-2	2,4,6- Trichlorophenol	520[e]	390[e]	11,000[e]	540[e]	0.2[e,i]	0.77[i]	0.66

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
	Inorganics							
7440-36-0	Antimony	820[b]	-----[c]	82[b]	-----[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	---[t]	1,200[e]	61[b]	25,000[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	140,000[b]	910,000[b]	14,000[b]	870,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	4,100[b]	2,100[e]	410[b]	44,000[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	410,000[b]	---[c]	41,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	2,000[b,r]	2,800[e]	200[b,r]	59,000[e]	0.005[m]	0.05[m]	*
7440-70-2	Calcium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
16887-00-6	Chloride	-------[c]	-----[c]	-----[c]	-----[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	6,100[b]	420[e]	4,100[b]	690[b]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	1,000,000[b]	-----[c]	310,000[b]	-----[c]	-----[g]	-----[g]	*
18540-29-9	Chromium, ion, hexavalent	6,100[b]	420[e]	4,100[b]	690[b]	-----	-----	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-48-4	Cobalt	120,000[b]	-----[c]	12,000[b]	-----[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	82,000[b]	-----[c]	8,200[b]	-----[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	41,000[b]	-----[c]	4,100[b]	-----[c]	0.2[q,m]	0.6[q,m]	*
7782-41-4	Fluoride	120,000[b]	-----[c]	12,000[b]	-----[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	-----[c]	-----[c]	-----[c]	-----[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	800[y]	-----[c]	700[y]	-----[c]	0.0075[m]	0.1[m]	*
7439-95-4	Magnesium[n]	---[g]	---[c]	730,000	---[c]	---[c]	---[c]	*
7439-96-5	Manganese	41,000 [b,w]	91,000[b]	4,100 [b,w]	8,700[b]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n,s]	610[b]	16[b]	61[b]	0.1[b]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	41,000[b]	21,000[c]	4,100[b]	440,000[c]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	1,000,000[b]	-----[c]	330,000[b]	-----[c]	10.0[q, m]	100[q]	*
7723-14-0	Phosphorus[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-09-7	Potassium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
7782-49-2	Selenium[l,n]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	0.05[m]	*
7440-22-4	Silver	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	-----	*
7440-23-5	Sodium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
14808-79-8	Sulfate	-----[c]	-----[c]	-----[c]	-----[c]	400[m]	400[m]	*
7440-28-0	Thallium	160[b,u]	-----[c]	160[b,u]	-----[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	14,000[b]	-----[c]	1,400[b]	-----[c]	0.049[m]	0.1[m]	*
7440-66-6	Zinc[l]	610,000[b]	-----[c]	61,000[b]	-----[c]	5.0[m]	10[m]	*

"*" indicates that the ADL is less than or equal to the specified remediation objective.

NA means Not Available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Remediation Objective Notations (2nd, 5th thru 8th Columns)

[a] oil remediation objectives based on human health criteria only.
[b] Calculated values correspond to a target hazard quotient of 1.
[c] No toxicity criteria available for this route of exposure.

[d] Soil saturation concentration ($C_{[sat]}$) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.

[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.

[h] 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Requests for approval of a Tier 3 evaluation must address the applicability of 40 CFR 761.

[i] Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.

[j] Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.

[l] Potential for soil-plant-human exposure.

[m] The person conducting the remediation has the option to use: (1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; (2) the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or (3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.

[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.

[o] For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.

[p] For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.

[q] The TCLP extraction must be done using water at a pH of 7.0.

[r] Value based on dietary Reference Dose.

[s] Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.

[t] For the ingestion route for arsenic for industrial/commercial, see 742.Appendix A, Table G.

[u] Value based on Reference Dose for Thallium sulfate (CAS No. 7446-18-6).

[w] Value based on Reference Dose adjusted for dietary intake.

[x] For any populated areas as defined in Section 742.200, Appendix A, Table H may be used.

[y] Value based on maintaining fetal blood lead below 10 ug/dl, using the USEPA adults Blood Lead Model.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table C pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Soil Component of the Groundwater Ingestion Route (Class I Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Inorganics											
Antimony	5	5	5	5	5	5	5	5	5	5	5
Arsenic	25	26	27	28	29	29	29	30	31	32	33
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100	—[a]	—[a]
Beryllium	1.1	2.1	3.4	6.6	22	63	140	1,000	8,000	—[a]	—[a]
Cadmium	1.0	1.7	2.7	3.7	5.2	7.5	11	59	430	—[a]	—[a]
Chromium (+6)	70	62	54	46	40	38	36	32	28	24	21
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000	—[a]	—[a]
Cyanide	40	40	40	40	40	40	40	40	40	40	40
Lead	23	23	23	23	107	107	107	107	107	107	282
Mercury	0.01	0.01	0.03	0.15	0.89	2.1	3.3	6.4	8.0	—[a]	—[a]
Nickel	20	36	56	76	100	130	180	700	3,800	—[a]	—[a]
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4	1.8	1.3
Silver	0.24	0.33	0.62	1.5	4.4	8.5	13	39	110	—[a]	—[a]

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Thallium	1.6	1.8	2.0	2.4	2.6	2.8	3.0	3.4	3.8	4.4	4.9
Vanadium	980	980	980	980	980	980	980	980	980	980	980
Zinc	1,000	1,800	2,600	3,600	5,100	6,200	7,500	16,000	53,000	—[a]	—[a]
Organics											
Benzoic Acid	440	420	410	400	400	400	400	400	400	400	400
2-Chlorophenol	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.6	3.1	2.2	1.5
2,4-Dichlorophenol	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.86	0.69	0.56	0.48
Dinoseb	8.4	4.5	1.9	0.82	0.43	0.34	0.31	0.27	0.25	0.25	0.25
Pentachlorophenol	0.54	0.32	0.15	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.02
2,4,5-TP (Silvex)	26	16	12	11	11	11	11	11	11	11	11
2,4,5-Trichlorophenol	400	390	390	370	320	270	230	130	64	36	26
2,4,6-Trichlorophenol	0.37	0.36	0.34	0.29	0.20	0.15	0.13	0.09	0.07	0.07	0.07

[a] No data available for this pH range.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table D pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Soil Component of the Groundwater Ingestion Route (Class II Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Inorganics											
Antimony	20	20	20	20	20	20	20	20	20	20	20
Arsenic	100	100	100	110	110	120	120	120	120	130	130
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100	—[a]	—[a]
Beryllium	140	260	420	820	2,800	7,900	17,000	130,000	1,000,000	—[a]	—[a]
Cadmium	10	17	27	37	52	75	110	590	4,300	—[a]	—[a]
Chromium (+6)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000	—[a]	—[a]
Cyanide	120	120	120	120	120	120	120	120	120	120	120
Lead	300	300	300	300	1,420	1,420	1,420	1,420	1,420	1,420	3,760
Mercury	0.05	0.06	0.14	0.75	4.4	10	16	32	40	—[a]	—[a]
Nickel	400	730	1,100	1,500	2,000	2,600	3,500	14,000	76,000	—[a]	—[a]
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4	1.8	1.3
Thallium	16	18	20	24	26	28	30	34	38	44	49

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Zinc	2,000	3,600	5,200	7,200	10,000	12,000	15,000	32,000	110,000	—[a]	—[a]
Organics											
Benzoic Acid	440	420	410	400	400	400	400	400	400	400	400
2-Chlorophenol	20	20	20	20	20	20	19	3.6	3.1	2.2	1.5
2,4-Dichlorophenol	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.86	0.69	0.56	0.48
Dinoseb	84	45	19	8.2	4.3	3.4	3.1	2.7	2.5	2.5	2.5
Pentachlorophenol	2.7	1.6	0.75	0.33	0.18	0.15	0.12	0.11	0.10	0.10	0.10
2,4,5-TP (Silvex)	130	79	62	57	55	55	55	55	55	55	55
2,4,5-Trichlorophenol	2,000	2,000	1,900	1,800	1,600	1,400	1,200	640	64	36	26
2,4,6-Trichlorophenol	1.9	1.8	1.7	1.4	1.0	0.77	0.13	0.09	0.07	0.07	0.07

[a] No data available for this pH range.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE E Tier 1 Groundwater Remediation Objectives for the Groundwater Component of the Groundwater Ingestion Route

		Groundwater Remediation Objective	
CAS No.	Chemical Name Organics	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	0.42	2.1
67-64-1	Acetone	6.3	6.3
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	0.014[a]	0.07
120-12-7	Anthracene	2.1	10.5
1912-24-9	Atrazine	0.003[c]	0.015[c]
71-43-2	Benzene	0.005[c]	0.025[c]
56-55-3	Benzo(*a*)anthracene	0.00013[a]	0.00065
205-99-2	Benzo(*b*)fluoranthene	0.00018[a]	0.0009
207-08-9	Benzo(*k*)fluroanthene	0.00017[a]	0.00085
50-32-8	Benzo(*a*)pyrene	0.0002[a,c]	0.002[c]
65-85-0	Benzoic Acid	28	28
111-44-4	Bis(2-chloroethyl)ether	0.01[a]	0.01
117-81-7	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	0.006[c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.0002[a]	0.0002
75-25-2	Bromoform	0.001[a]	0.001
71-36-3	Butanol	0.7	0.7
85-68-7	Butyl benzyl phthalate	1.4	7.0
86-74-8	Carbazole	---	---
1563-66-2	Carbofuran	0.04[c]	0.2[c]
75-15-0	Carbon disulfide	0.7	3.5
56-23-5	Carbon tetrachloride	0.005[c]	0.025[c]
57-74-9	Chlordane	0.002[c]	0.01[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
106-47-8	4-Chloroaniline (ρ-Chloroaniline)	0.028	0.028
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.14	0.14
67-66-3	Chloroform	0.0002[a]	0.001
95-57-8	2-Chlorophenol (pH 4.9-7.3)	0.035	0.175
	2-Chlorophenol (pH 7.4-8.0)	0.035	0.035
218-01-9	Chrysene	0.0015[a]	0.0075
94-75-7	2,4-D	0.07[c]	0.35[c]
75-99-0	Dalapon	0.2[c]	2.0[c]
72-54-8	DDD	0.014[a]	0.07
72-55-9	DDE	0.01[a]	0.05
50-29-3	DDT	0.006[a]	0.03
53-70-3	Dibenzo(*a,h*)anthracene	0.0003[a]	0.0015
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.002[c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[c]	0.0005[c]
84-74-2	Di-*n*-butyl phthalate	0.7	3.5
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	0.6[c]	1.5[c]
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	0.075[c]	0.375[c]
91-94-1	3,3'-Dichlorobenzidine	0.02[a]	0.1
75-34-3	1,1-Dichloroethane	0.7	3.5
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	0.025[c]
75-35-4	1,1-Dichloroethylene[b]	0.007[c]	0.035[c]
156-59-2	*cis*-1,2-Dichloroethylene	0.07[c]	0.2[c]
156-60-5	*trans*-1,2-Dichloroethylene	0.1[c]	0.5[c]
120-83-2	2,4-Dichlorophenol	0.021	0.021

78-87-5	1,2-Dichloropropane	0.005[c]	0.025[c]
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	0.001[a]	0.005

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
60-57-1	Dieldrin	0.009[a]	0.045
84-66-2	Diethyl phthalate	5.6	5.6
105-67-9	2,4-Dimethylphenol	0.14	0.14
51-28-5	2,4-Dinitrophenol	0.014	0.014
121-14-2	2,4-Dinitrotoluene	0.00002[a]	0.00002
606-20-2	2,6-Dinitrotoluene	0.00031[a]	0.00031
88-85-7	Dinoseb	0.007[c]	0.07[c]
117-84-0	Di-*n*-octyl phthalate	0.14	0.7
115-29-7	Endosulfan	0.042	0.21
145-73-3	Endothall	0.1[c]	0.1[c]
72-20-8	Endrin	0.002[c]	0.01[c]
100-41-4	Ethylbenzene	0.7[c]	1.0[c]
206-44-0	Fluoranthene	0.28	1.4
86-73-7	Fluorene	0.28	1.4
76-44-8	Heptachlor	0.0004[c]	0.002[c]
1024-57-3	Heptachlor epoxide	0.0002[c]	0.001[c]
118-74-1	Hexachlorobenzene	0.00006[a]	0.0003
319-84-6	*alpha*-HCH (*alpha*-BHC)	0.00011[a]	0.00055
58-89-9	*Gamma*-HCH (Lindane)	0.0002[c]	0.001[c]
77-47-4	Hexachlorocyclopentadiene	0.05[c]	0.5[c]
67-72-1	Hexachloroethane	0.007	0.035
193-39-5	Indeno(1,2,3-*c,d*)pyrene	0.00043[a]	0.00215
78-59-1	Isophorone	1.4	1.4
72-43-5	Methoxychlor	0.04[c]	0.2[c]
74-83-9	Methyl bromide (Bromomethane)	0.0098	0.049
1634-04-4	Methyl tertiary-butyl ether	0.07	0.07
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
95-48-7	2-Methylphenol (*o*-Cresol)	0.35	0.35
91-20-3	Naphthalene	0.14	0.22

98-95-3	Nitrobenzene[b]	0.0035	0.0035

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
86-30-6	*N*-Nitrosodiphenylamine	0.0032[a]	0.016
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.0018[a]	0.0018
87-86-5	Pentachlorophenol	0.001[c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)	0.0005[c]	0.0025[c]
129-00-0	Pyrene	0.21	1.05
122-34-9	Simazine	0.004[c]	0.04[c]
100-42-5	Styrene	0.1[c]	0.5[c]
93-72-1	2,4,5-TP (Silvex)	0.05[c]	0.25[c]
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.005[c]	0.025[c]
108-88-3	Toluene	1.0[c]	2.5[c]
8001-35-2	Toxaphene	0.003[c]	0.015[c]
120-82-1	1,2,4-Trichlorobenzene	0.07[c]	0.7[c]
71-55-6	1,1,1-Trichloroethane[b]	0.2[c]	1.0[c]
79-00-5	1,1,2-Trichloroethane	0.005[c]	0.05[c]
79-01-6	Trichloroethylene	0.005[c]	0.025[c]
95-95-4	2,4,5-Trichlorophenol (pH 4.9-7.8)	0.7	3.5
	2,4,5-Trichlorophenol (pH 7.9-8.0)	0.7	0.7
88-06-2	2,4,6-Trichlorophenol (pH 4.9-6.8)	0.01[a]	0.05
	2,4,6-Trichlorophenol (pH 6.9-8.0)	0.01	0.01
108-05-4	Vinyl acetate	7.0	7.0
75-01-4	Vinyl chloride	0.002[c]	0.01[c]
1330-20-7	Xylenes (total)	10.0[c]	10.0[c]

CAS No.	Chemical Name	Groundwater Remediation Objective	
		Class I (mg/L)	Class II (mg/L)
	Inorganics		
7440-36-0	Antimony	0.006[c]	0.024[c]
7440-38-2	Arsenic	0.05[c]	0.2[c]
7440-39-3	Barium	2.0[c]	2.0[c]
7440-41-7	Beryllium	0.004[c]	0.5[c]
7440-42-8	Boron	2.0[c]	2.0[c]
7440-43-9	Cadmium	0.005[c]	0.05[c]
7440-70-2	Calcium	---[d]	---[d]
16887-00-6	Chloride	200[c]	200[c]
7440-47-3	Chromium, total	0.1[c]	1.0[c]
18540-29-9	Chromium, ion, hexavalent	---	---
7440-48-4	Cobalt	1.0[c]	1.0[c]
7440-50-8	Copper	0.65[c]	0.65[c]
57-12-5	Cyanide	0.2[c]	0.6[c]
7782-41-4	Fluoride	4.0[c]	4.0[c]
15438-31-0	Iron	5.0[c]	5.0[c]
7439-92-1	Lead	0.0075[c]	0.1[c]
7439-95-4	Magnesium	---[d]	---[d]
7439-96-5	Manganese	0.15[c]	10.0[c]
7439-97-6	Mercury	0.002[c]	0.01[c]
7440-02-0	Nickel	0.1[c]	2.0[c]
14797-55-8	Nitrate as N	10.0[c]	100[c]
7723-14-0	Phosphorus	---[d]	---[d]
7440-09-7	Potassium	---[d]	---[d]
7782-49-2	Selenium	0.05[c]	0.05[c]

CAS No.	Chemical Name	Groundwater Remediation Objective	
		Class I (mg/L)	Class II (mg/L)
7440-22-4	Silver	0.05[c]	---
7440-23-5	Sodium	---[d]	---[d]
14808-79-8	Sulfate	400[c]	400[c]
7440-28-0	Thallium	0.002[c]	0.02[c]
7440-62-2	Vanadium[b]	0.049	0.1
7440-66-6	Zinc	5.0[c]	10[c]

Chemical Name and Groundwater Remediation Objective Notations

[a] The groundwater remediation objective is equal to the ADL for carcinogens according to the procedures specified in 35 Ill. Adm. Code 620.

[b] Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.

[c] Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

[d] This chemical is included in the Total Dissolved Solids (TDS) Groundwater Quality Standard of 1,200 mg/l pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE G: Tier 1 Soil Gas Remediation Objectives for the Outdoor Inhalation Exposure Route[a]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
67-64-1	Acetone	750,000[e]	750,000[e]	750,000[e]
71-43-2	Benzene	420[c]	800[c]	1,100[c]
111-44-4	Bis(2-chloroethyl)ether	1.3[c]	2.4[c]	3.4[c]
75-27-4	Bromodichloromethane	450,000[e]	450,000[e]	450,000[e]
75-25-2	Bromoform	1,800[c]	3,500[c]	4,900[c]
71-36-3	Butanol	29,000[e]	29,000[e]	29,000[e]
78-93-3	2-Butanone (MEK)	380,000[e]	380,000[e]	15,000[b]
75-15-0	Carbon disulfide	1,500,000[e]	1,500,000[e]	48,000[b]
56-23-5	Carbon tetrachloride	290[c]	550[c]	770[c]
108-90-7	Chlorobenzene	36,000[b]	57,000[b]	3,700[b]
124-48-1	Chlorodibromomethane	57,000[e]	57,000[e]	150[b]
67-66-3	Chloroform	110[c]	200[c]	290[c]
95-57-8	2-Chlorophenol	17,000[e]	17,000[e]	17,000[e]
75-99-0	Dalapon	1,500[e]	1,500[e]	1,500[e]
96-12-8	1,2-Dibromo-3-chloropropane	0.14[c]	0.27[c]	0.38[c]
106-93-4	1,2-Dibromoethane	2.9[c]	5.6[c]	7.9[c]
95-50-1	1,2-Dichlorobenzene	11,000[e]	11,000[e]	6,700[b]
106-46-7	1,4-Dichlorobenzene	8,400[e]	8,400[e]	6,400[b]
75-71-8	Dichlorodifluoromethane	890,000[b]	1,400,000[b]	92,000[b]
75-34-3	1,1-Dichloroethane	870,000[b]	1,300,000[e]	90,000[b]
107-06-2	1,2-Dichloroethane	67[c]	130[c]	180[c]
75-35-4	1,1-Dichloroethylene	520,000[b]	820,000[b]	5,300[b]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[e]	1,100,000[e]	1,100,000[e]
156-60-5	*trans*-1,2-Dichloroethylene	120,000[b]	190,000[b]	12,000[b]
78-87-5	1,2-Dichloropropane	240[c]	470[c]	110[c]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	1,900[c]	3,700[c]	1,400[c]
123-91-1	p-Dioxane	16[c]	30[c]	42[c]
100-41-4	Ethylbenzene	59,000[e]	59,000[e]	8,500[b]
76-44-8	Heptachlor	0.40[c]	0.76[c]	1.1[c]
118-74-1	Hexachlorobenzene	0.26[c]	0.28[e]	0.28[e]
77-47-4	Hexachlorocyclopentadiene	85[b]	140[b]	440[b]
67-72-1	Hexachloroethane	2,800[e]	2,800[e]	2,800[e]
78-59-1	Isophorone	3,400[e]	3,400[e]	1,500[b]
98-82-8	Isopropylbenzene (Cumene)	30,000[e]	30,000[e]	30,000[e]
7439-97-6	Mercury[f]	22[e]	22[e]	0.62[b]
74-83-9	Methyl bromide	12,000[b]	19,000[b]	2,400[b]
1634-04-4	Methyl tertiary-butyl ether	1,200,000[e]	1,200,000[e]	23,000[b]
75-09-2	Methylene chloride	6,100[c]	12,000[c]	5,100[b]
91-57-6	2-Methylnaphthalene	530[e]	530[e]	530[e]
95-48-7	2-Methylphenol (o-cresol)	1,800[e]	1,800[e]	410[b]
91-20-3	Naphthalene	560[b]	620[e]	5.8[b]
98-95-3	Nitrobenzene	6.5[c]	12[c]	10[b]
621-64-7	n-Nitrosodi-n-propylamine	0.056[c]	0.11[c]	0.15[c]
108-95-2	Phenol	1,500[e]	1,500[e]	79[b]
1336-36-3	Polychlorinated biphenyls (PCBs)	---[d]	---[d]	---[d]
100-42-5	Styrene	34,000[e]	34,000[e]	16,000[b]
127-18-4	Tetrachloroethylene	360[c]	690[c]	970[c]
108-88-3	Toluene	140,000[e]	140,000[e]	50,000[b]
120-82-1	1,2,4-Trichlorobenzene	1,000[b]	1,600[b]	110[b]
71-55-6	1,1,1-Trichloroethane	870,000[e]	870,000[e]	89,000[b]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
79-00-5	1,1,2-Trichloroethane	170,000[c]	170,000[c]	170,000[c]
79-01-6	Trichloroethylene	1,700[c]	3,300[c]	1,500[b]
75-69-4	Trichlorofluoromethane	2,100,000[b]	3,400,000[b]	220,000[b]
108-05-4	Vinyl acetate	160,000[b]	250,000[b]	1,600[b]
75-01-4	Vinyl chloride	780[c]	3,000[c]	3,000[b]
108-38-3	m-Xylene	52,000[e]	52,000[e]	3,100[b]
95-47-6	o-Xylene	41,000[e]	41,000[e]	2,600[b]
106-42-3	p-Xylene	55,000[e]	55,000[e]	3,300[b]
1330-20-7	Xylenes (total)	49,000[e]	49,000[e]	2,900[b]

Chemical Name and Remediation Objective Notations

[a] For the outdoor inhalation exposure route, it is acceptable to determine compliance by meeting either the soil or soil gas remediation objectives. The soil remediation objectives for the outdoor inhalation route are located in Appendix B, Tables A and B.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[d] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with IEPA Bureau of Land (BOL) if calculation of Tier 2 or 3 remediation objectives is desired.

e The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

f Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route – Diffusion and Advection[j]

Q_{soil} equals 83.33 cm^3/sec[a]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
67-64-1	Acetone	750,000[f]	750,000[f]	1,000,000[g]	1,000,000[g]
71-43-2	Benzene	0.37[c]	2.8[c]	0.11[c]	0.41[c]
111-44-4	Bis(2-chloroethyl)ether	0.014[c]	0.087[c]	0.083[c]	0.43[c]
75-27-4	Bromodichloromethane	450,000[f]	450,000[f]	6,700[g]	6,700[g]
75-25-2	Bromoform	11[c]	52[c]	3.1[c]	12[c]
71-36-3	Butanol	29,000[f]	29,000[f]	74,000[g]	74,000[g]
78-93-3	2-Butanone (MEK)	6,400[b]	40,000[b]	10,000[b]	48,000[b]
75-15-0	Carbon disulfide	780[b]	5,300[b]	67[b]	210[b]
56-23-5	Carbon tetrachloride	0.21[c]	1.5[c]	0.020[c]	0.076[c]
108-90-7	Chlorobenzene	69[b]	420[b]	26[b]	82[b]
124-48-1	Chlorodibromomethane	57,000[f]	57,000[f]	2,600[g]	2,600[g]
67-66-3	Chloroform	0.11[c]	0.92[c]	0.07[i]	0.15[c]
95-57-8	2-Chlorophenol	17,000[f]	17,000[f]	22,000[g]	22,000[g]
75-99-0	Dalapon[e]	1,500[f]	1,500[f]	900,000[g]	900,000[g]
96-12-8	1,2-Dibromo-3-chloropropane[e]	0.0012[c]	0.0062[c]	0.00065[c]	0.0027[c]
106-93-4	1,2-Dibromoethane	0.0078[c]	0.048[c]	0.0035[c]	0.014[c]
95-50-1	1,2-Dichlorobenzene	290[b]	1,700[b]	140[b]	160[g]
106-46-7	1,4-Dichlorobenzene	1,200[b]	6,800[b]	79[g]	79[g]
75-71-8	Dichlorodifluoromethane	270[b]	1,700[b]	3.0[b]	9.2[b]
75-34-3	1,1-Dichloroethane	690[b]	4,200[b]	180[b]	580[b]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
107-06-2	1,2-Dichloroethane	0.099[c]	0.81[c]	0.054[c]	0.22[c]
75-35-4	1,1-Dichloroethylene	240[b]	1,600[b]	24[b]	74[b]
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[f]	1,100,000[f]	3,500[g]	3,500[g]
156-60-5	*trans*-1,2-Dichloroethylene	85[b]	510[b]	16[b]	51[b]
78-87-5	1,2-Dichloropropane	0.31[c]	2.3[c]	0.12[c]	0.48[c]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	0.90[c]	6.2[c]	0.14[c]	0.52[c]
123-91-1	p-Dioxane	0.22[c]	2.3[c]	2.9[c]	25[c]
100-41-4	Ethylbenzene	1,3[c]	9.3[c]	0.37[c]	1.4[c]
76-44-8	Heptachlor	0.0063[c]	0.032[c]	0.0025[c]	0.0096[c]
118-74-1	Hexachlorobenzene	0.0087[c]	0.057[c]	0.0059[c]	0.0062[g]
77-47-4	Hexachlorocyclopentadiene	0.58[b]	2.6[b]	0.084[b]	0.26[b]
67-72-1	Hexachloroethane	2,800[f]	2,800[f]	50[g]	50[g]
78-59-1	Isophorone	2,900[b]	3,400[f]	12,000[g]	12,000[g]
98-82-8	Isopropylbenzene (Cumene)	600[b]	3,500[b]	2.7[b]	8.4[b]
7439-97-6	Mercury[h]	0.42[b]	2.5[b]	0.053[b]	0.060[g]
74-83-9	Methyl bromide	6.9[b]	42[b]	1.5[b]	4.8[b]
1634-04-4	Methyl tertiary-butyl ether	3,700[b]	24,000[b]	1,900[b]	6,800[b]
75-09-2	Methylene chloride	5.6[c]	45[c]	2.1[c]	8.2[c]
91-57-6	2-Methylnaphthalene	530[f]	530[f]	25[g]	25[g]
95-48-7	2-Methylphenol (o-cresol)	600[b]	1,800[f]	26,000[g]	26,000[g]
91-20-3	Naphthalene	0.11[c]	0.75[c]	0.075[c]	0.32[c]
98-95-3	Nitrobenzene	0.077[c]	0.57[c]	0.34[c]	2.0[c]
621-64-7	n-Nitrosodi-n-propylamine	0.0016[c]	0.012[c]	0.044[c]	0.27[c]
108-95-2	Phenol	140[b]	1,300[b]	28,000[b]	83,000[g]

CAS No.	Chemical Name	Soil Gas		Groundwater	
		Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
1336-36-3	Polychlorinated biphenyls (PCBs)	---[d]	---[d]	---[d]	---[d]
100-42-5	Styrene	1,400[b]	8,500[b]	310[g]	310[g]
127-18-4	Tetrachloroethylene	0.55[c]	4.0[c]	0.091[c]	0.34[c]
108-88-3	Toluene	6,200[b]	40,000[b]	530[g]	530[g]
120-82-1	1,2,4-Trichlorobenzene	5.4[b]	25[b]	1.8[b]	5.9[b]
71-55-6	1,1,1-Trichloroethane	6,600[b]	41,000[b]	1,000[b]	1,300[g]
79-00-5	1,1,2-Trichloroethane	170,000[f]	170,000[f]	4,400[g]	4,400[g]
79-01-6	Trichloroethylene	1.5[c]	12[c]	0.34[c]	1.3[c]
75-69-4	Trichlorofluoromethane	860[b]	5,600[b]	26[b]	82[b]
108-05-4	Vinyl acetate	250[b]	1,600[b]	160[b]	550[b]
75-01-4	Vinyl chloride	0.29[c]	4.8[c]	0.028[c]	0.21[c]
108-38-3	m-Xylene	140[b]	850[b]	43[b]	130[b]
95-47-6	o-Xylene	120[b]	790[b]	40[b]	130[b]
106-42-3	p-Xylene	130[b]	820[b]	38[b]	120[b]
1330-20-7	Xylenes (total)[e]	140[b]	840[b]	30[b]	93[b]

Chemical Name and Remediation Objective Notations

[a] Compliance is determined by meeting either the soil gas remediation objectives or the groundwater remediation objectives. See Sections 742.505 and 742.515.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[d] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired.

[e] Groundwater remediation objective calculated at 25°C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (T_c) and enthalpy of vaporization at the normal boiling point ($H_{v,b}$) are not available. For Xylenes (total), the enthalpy of vaporization at the normal boiling point ($H_{v,b}$) is not available.

[f] The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

[g] The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the ingestion route of exposure.

[h] Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

[i] The value shown is the Groundwater Remediation Objective listed in Appendix B, Table E.

[j] Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on-grade, though the remediation objectives in this table are also considered protective of occupants of buildings with full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply when the existing or potential building has neither a full concrete slab-on-grade nor a full concrete basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, a partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312 meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE I: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route – Diffusion Only[j]

Q_{soil} equals 0.0 cm^3/sec[a,b]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
67-64-1	Acetone	750,000[g]	750,000[g]	1,000,000[h]	1,000,000[h]
71-43-2	Benzene	41[d]	300[d]	0.41[d]	2.6[d]
111-44-4	Bis(2-chloroethyl)ether	1.9[d]	14[d]	6.6[d]	48[d]
75-27-4	Bromodichloromethane	450,000[g]	450,000[g]	6,700[h]	6,700[h]
75-25-2	Bromoform	1,800[d]	13,000[d]	170[d]	1,300[d]
71-36-3	Butanol	29,000[g]	29,000[g]	74,000[h]	74,000[h]
78-93-3	2-Butanone (MEK)	380,000[g]	380,000[g]	220,000[h]	220,000[h]
75-15-0	Carbon disulfide	81,000[c]	500,000[c]	170[c]	820[c]
56-23-5	Carbon tetrachloride	24[d]	180[d]	0.052[d]	0.31[d]
108-90-7	Chlorobenzene	8,300[c]	51,000[c]	130[c]	470[h]
124-48-1	Chlorodibromomethane	57,000[g]	57,000[g]	2,600[h]	2,600[h]
67-66-3	Chloroform	12[d]	87[d]	0.17[d]	1.1[d]
95-57-8	2-Chlorophenol	17,000[g]	17,000[g]	22,000[h]	22,000[h]
75-99-0	Dalapon[f]	1,500[g]	1,500[g]	900,000[h]	900,000[h]
96-12-8	1,2-Dibromo-3-chloropropane[f]	0.17[d]	1.3[d]	0.029[d]	0.21[d]
106-93-4	1,2-Dibromoethane	1.1[d]	7.9[d]	0.073[d]	0.52[d]
95-50-1	1,2-Dichlorobenzene	11,000[g]	11,000[g]	160[h]	160[h]
106-46-7	1,4-Dichlorobenzene	8,400[g]	8,400[g]	79[h]	79[h]
75-71-8	Dichlorodifluoromethane	32,000[c]	200,000[c]	6.8[c]	33[c]
75-34-3	1,1-Dichloroethane	81,000[c]	500,000[c]	750[c]	4,100[c]

CAS No.	Chemical Name	Soil Gas		Groundwater	
		Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
107-06-2	1,2-Dichloroethane	10[d]	76[d]	0.50[d]	3.5[d]
75-35-4	1,1-Dichloroethylene	27,000[c]	160,000[c]	61[c]	300[c]
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[g]	1,100,000[g]	3,500[h]	3,500[h]
156-60-5	*trans*-1,2-Dichloroethylene	10,000[c]	63,000[c]	58[c]	310[c]
78-87-5	1,2-Dichloropropane	36[d]	260[d]	0.67[d]	4.5[d]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	110[d]	830[d]	0.42[d]	2.6[d]
123-91-1	p-Dioxane	15[d]	110[d]	140[d]	1,000[d]
100-41-4	Ethylbenzene	150[d]	1,100[d]	1.3[d]	8.1[d]
76-44-8	Heptachlor	0.97[d]	7.1[d]	0.058[d]	0.18[h]
118-74-1	Hexachlorobenzene	0.28[g]	0.28[g]	0.0062[h]	0.0062[h]
77-47-4	Hexachlorocyclopentadiene	86[c]	530[c]	0.29[c]	1.5[c]
67-72-1	Hexachloroethane	2,800[g]	2,800[g]	50[h]	50[h]
78-59-1	Isophorone	3,400[g]	3,400[g]	12,000[h]	12,000[h]
98-82-8	Isopropylbenzene (Cumene)	30,000[g]	30,000[g]	6.2[c]	30[c]
7439-97-6	Mercury[i]	22[g]	22[g]	0.060[h]	0.060[h]
74-83-9	Methyl bromide	830[c]	5,100[c]	6.1[c]	33[c]
1634-04-4	Methyl tertiary-butyl ether	420,000[c]	1,200,000[g]	30,000[c]	51,000[h]
75-09-2	Methylene chloride	590[d]	4,400[d]	12[d]	84[d]
91-57-6	2-Methylnaphthalene	530[g]	530[g]	25[h]	25[h]
95-48-7	2-Methylphenol (o-cresol)	1,800[g]	1,800[g]	26,000[h]	26,000[h]
91-20-3	Naphthalene	14[d]	100[d]	1.8[d]	13[d]
98-95-3	Nitrobenzene	9.0[d]	66[d]	23[d]	170[d]
621-64-7	n-Nitrosodi-n-propylamine	0.18[d]	1.3[d]	3.3[d]	24[d]
108-95-2	Phenol	1,500[g]	1,500[g]	83,000[h]	83,000[h]
1336-36-3	Polychlorinated biphenyls	---[e]	---[e]	---[e]	---[e]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
	(PCBs)				
100-42-5	Styrene	34,000[g]	34,000[g]	310[h]	310[h]
127-18-4	Tetrachloroethylene	66[d]	490[d]	0.26[d]	1.6[d]
108-88-3	Toluene	140,000[g]	140,000[g]	530[h]	530[h]
120-82-1	1,2,4-Trichlorobenzene	800[c]	4,300[g]	35[h]	35[h]
71-55-6	1,1,1-Trichloroethane	770,000[c]	870,000[g]	1,300[h]	1,300[h]
79-00-5	1,1,2-Trichloroethane	170,000[g]	170,000[g]	4,400[h]	4,400[h]
79-01-6	Trichloroethylene	180[d]	1,300[d]	1.1[d]	6.7[d]
75-69-4	Trichlorofluoromethane	97,000[c]	600,000[c]	62[c]	300[c]
108-05-4	Vinyl acetate	28,000[c]	170,000[c]	2,500[c]	15,000[c]
75-01-4	Vinyl chloride	30[d]	440[d]	0.065[d]	0.75[d]
108-38-3	m-Xylene	17,000[d]	52,000[c]	160[c]	160[h]
95-47-6	o-Xylene	14,000[d]	41,000[c]	170[c]	180[h]
106-42-3	p-Xylene	16,000[d]	55,000[c]	140[c]	160[h]
1330-20-7	Xylenes (total)[f]	17,000[d]	49,000[c]	96[c]	110[h]

Chemical Name and Remediation Objective Notations

[a] Compliance is determined by meeting both the soil gas remediation objectives and the groundwater remediation objectives. See Sections 742.505 and 742.515.

[b] Remediation objectives relying on this table require use of institutional controls in accordance with Subpart J.

[c] Calculated values correspond to a target hazard quotient of 1.

[d] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[e] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired

[f] Groundwater remediation objective calculated at 25°C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (T_c) and enthalpy of vaporization at the normal boiling point ($H_{v,b}$) are not available. For Xylenes (total), the enthalpy of vaporization at the normal boiling point ($H_{v,b}$) is not available.

[g] The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

[h] The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the inhalation route of exposure.

[i] Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

[j] Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on-grade, though the remediation objectives in this table are also considered protective of occupants of buildings with full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply when the existing or potential building has neither a full concrete slab-on-grade nor a full concrete basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, a partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Stantec

APPENDIX E
SAMPLE CHAIN-OF-CUSTODY

Quality Assurance Project Plan
Site Investigation
BP Products North America Site, Inc. Site #5482

Pace Analytical®
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company	Report To	Attention
Address:	Copy To	Company Name
		Address
Email To:	Purchase Order No.:	Pace Quote Reference
Phone: Fax	Project Name:	Pace Project Manager
Requested Due Date/TAT:	Project Number:	Pace Profile #

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER _____

Site Location
STATE: _____

Requested Analysis Filtered (Y/N)

ITEM #	Section D Required Client Information SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	Matrix Codes MATRIX / CODE Drinking Water DW Water WT Waste Water WW Product P Soil/Solid SL Oil OL Wipe WP Air AR Tissue TS Other OT	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COLLECTED: COMPOSITE START TIME	COLLECTED: COMPOSITE END/GRAB DATE	COLLECTED: COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Y/N ↓ / Analysis Test ↓										Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
10																														
11																														
12																														

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

...in °C	...ved on (Y/N)	...tody ...l Coder ...(N)	...es Intact ...(N)

Instructions for completing Chain of Custody (COC)

1. **Section A and B:** Complete all Client information at top of sheet: company name, address, phone, fax, contact (the person to contact if there are questions, and who will receive the final report.), e-mail address (if available), PO#, Project Name and/or Project Number as you would like to see it appear on the report.

2. **Section C:** Invoice Information: Billing information is included in this section. This information should include the name and address of the person receiving the invoice.

3. Quote Reference should be completed if a quotation was provided by Pace Analytical. The Project Manager, and Profile No. will be completed by Pace Analytical Services.

4. **Site Location:** A separate COC must be filled out for each day of sample collection. Record the two letter postal code for the US state in which the samples were collected.

5. **Regulatory Agency:** List the program that is guiding the work to ensure proper regulations are followed.

6. **Section D:** Complete a Sample Description in the "SAMPLE ID' section as you would like it to appear on the laboratory report. The following information should also be included: the sample matrix, sample type (G (grab) or C (composite). When collecting a composite, the start time and end time should be documented in the respective boxes. The collection time for a grab (G) sample should be entered in the boxes marked 'Composite End/Grab'), Sample temp at collection (if required by state), the total number of containers, and preservative used.

7. Mark if the sample was filtered in the field by marking Y or N in 'Filtered' row by the Analysis requested.

8. Requested Analysis: List the required analysis and methods on the lines provided and place a check in the column for the samples requiring the analysis. Additional comments should be referenced in the bottom left hand corner or include attachments for extended lists of parameters.

9. The sampler should print their name in the space provided and sign their name followed by the date of the sampling event at the bottom of the COC in the spaces designated for 'SAMPLER NAME AND SIGNATURE'.

10. When relinquishing custody of the samples to a representative of the laboratory or other organization, indicate the Item Numbers of those samples being transferred; sign relinquished by, date and time, and include your affiliation.

***Important Note:**

Standard Turnaround Time is 2 Weeks/10 business days. Results will be delivered by end of business on the date due unless other arrangements have been made with your project manager.

Special Project Requirements such as Low Level Detection Limits or level of QC reported must be included on the chain of custody in the Additional Comments section.